PUBLIC WORKS

Devoted to the interests of the engineers and technical officials of the cities, counties and states

MAY, 1938

A. PRESCOTT FOLWELL, Editor — VOL. 69. NO. 5 — W. A. HARDENBERGH, Asso. Editor

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TIMEWASTERS

Some Solutions and Comments:

The bookworm problem offered a little simple arithmetic, and mental exercise. There were 9 pages with one digit, 90 pages with 2 digits, and 900 pages with 3 digits, a total of 999 pages and 2,889 digits. Since there were 3,001 digits, there were enough additional pages to make up 3,001-2,889, or 112 digits. These were 4-digit pages, and 112 ÷ 4 = 28. Therefore there were 999 + 28 or 1,027 pages. In the Mikey-Ikey affair, the seats could be divided in several ways. Our original solution showed 700 seats at $1, 190 seats at $20 and 110 seats at $50. Mr. Blunk says we also can sell 72 seats at $50, 288 seats at $20 and 640 seats at $1. Maybe there are other answers. Mr. Bevan says his friend could see most of the river when he stood on the 11th stair.

Come Bossy:

A circular tract of ground is fenced so as to contain exactly one acre. On the north side of the enclosure a white cow is tied by a rope having a length equal to the radius of the circle. Just opposite, on the south side, a black cow is tied with a rope of the same length. After these cows had eaten off all the grass which their respective ropes would permit, a farmer rented the remaining part of the circular pasture for his red cow at the rate of $10 per acre. How much should he pay? *Contributed by H. A. Blunk.*

For Reserve Officers

Reserve officers who have taken extension course work will feel at home with this one, contributed by John Bevan. A man is 2 miles from the nearest point A on a straight road. He wishes to reach a point B on the road, 4 miles from A. He can walk 4 miles per hour till he reaches the road and 5 miles per hour on the road. What is the least time required to reach B?

W. A. H.

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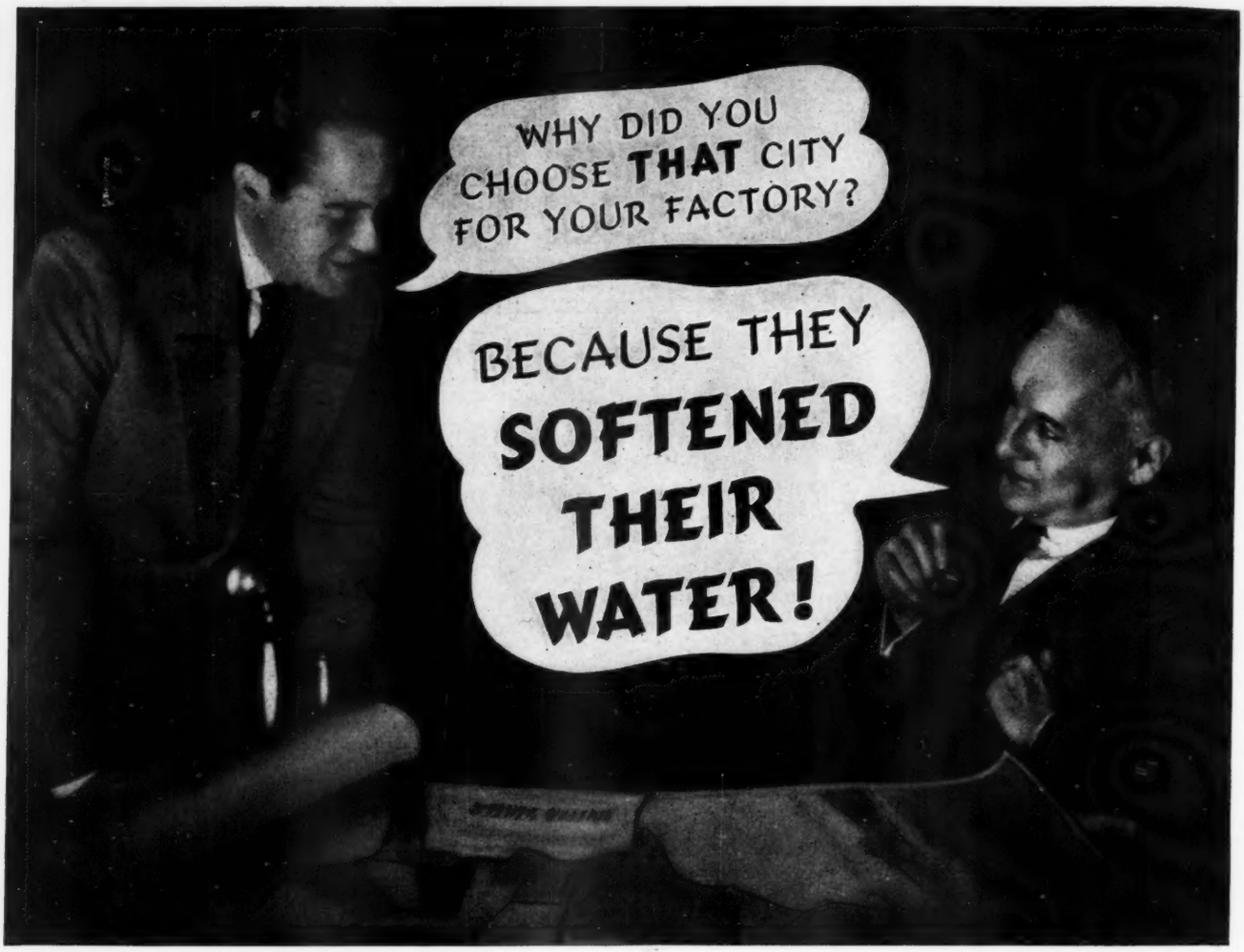

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PUBLIC WORKS
City, County and State Engineering and Construction

MAY, 1938
VOL. 69. NO. 5

Chemical Sewage Treatment for Danville, Ill.

By J. W. NEMOYER
Assistant Engineer, Greeley & Hansen

THE sewage disposal project of Danville, Ill., substantially completed in 1937 with the aid of PWA, had as a feature of major interest the unusual expedition in preliminary field work, design and construction that was required in the face of recurring obstacles.

The city had been ordered by the State Sanitary Water Board to cease pollution of the Vermilion river, but a sewer revenue bond issue for financing a disposal plant was voted down, and the city did not have unused general obligation bonding power adequate for the purpose.

Illinois state laws provide for sanitary districts, such a district being a municipality, superimposed on a municipality, having separate taxing and bonding powers, and the formation of such a district to serve a single municipality in effect increases its bonding power. Danville, believing its sewerage project could best be financed and administered through such a district, on Aug. 19, 1935, applied to PWA for federal assistance on this basis. That authority objected to backing a project to be administered by an embryonic sanitary district and financed by a bond issue not yet voted on, but schedules were established for prompt formation of a district and a grant was allowed by PWA in October, with the understanding that active construction begin by December 15. To make this possible necessitated receiving bids by December 2; and the Illinois sanitary district law requires advertisement of construction work for a period of 30 days, which necessitated advertising by November 2, which left only 17 days for preparation of plans and specifications and their approval by the State and Federal authorities.

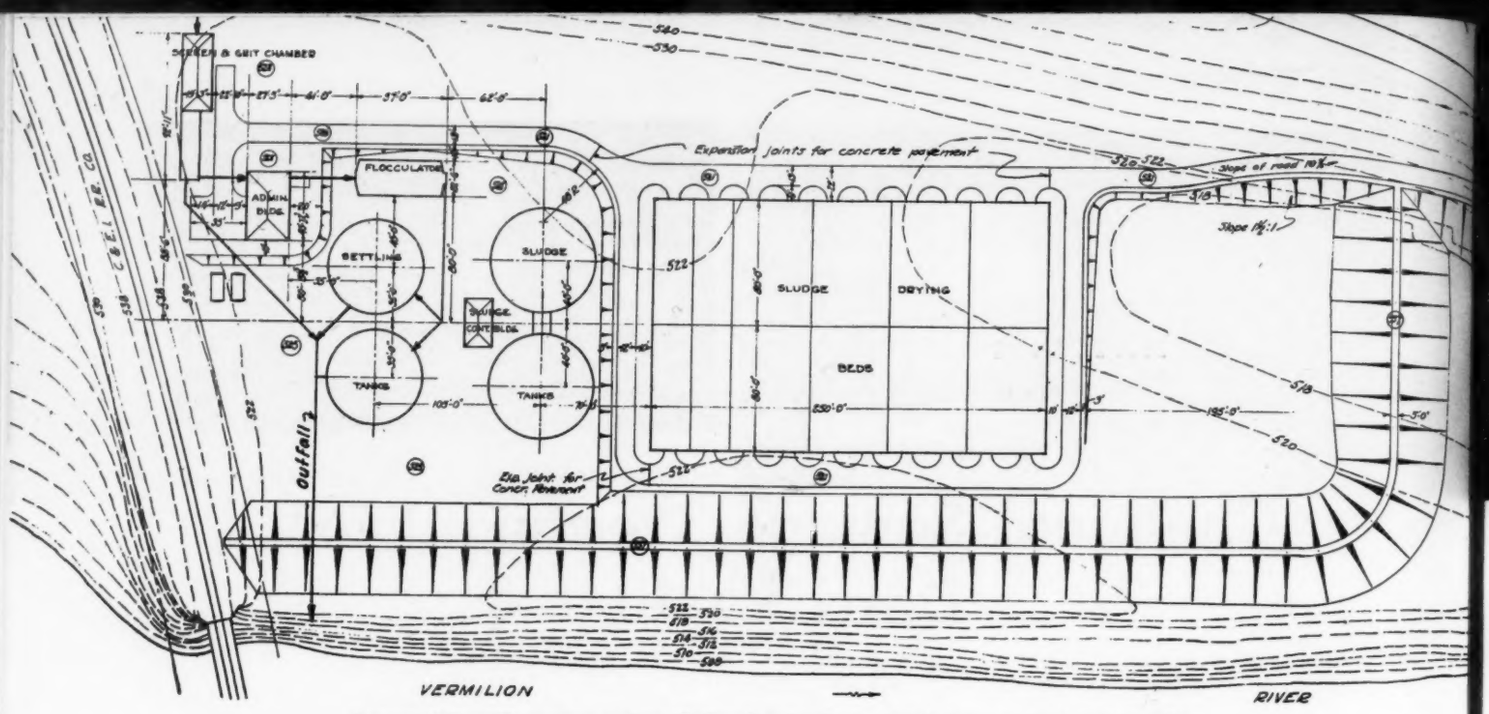
Chemical feed room. (A) Automatically operated dry feed machines for alum, lime and ferrous or ferric sulphate; (B) Ferric dissolving tank which is charged from floor of storage room immediately above; (C) Ferric storage tank; (D) Automatically operated ferric solution feed devices; (E) Diluting tank for ferric solution.

Obviously, some short cuts were indicated. Field work, plant layout, general structural arrangements, and machinery location and details could not, of course, be hurried. Detailed structural design was selected for expedition. Reinforced concrete structures were designed only so far as to permit approximate determinations of the thickness of concrete walls, slabs, etc., and the contract drawings were prepared on this basis without detailed dimensions or reinforcing steel. Concrete and reinforcing steel quantities were, perforce, only approximated.

The plans and specifications were approved early in November, and for two weeks before bids were received, contractors had plans adequate for intelligent bidding. Two months after awarding contracts was required for completing detailed working drawings, which were prepared piecemeal in an effort to keep the construction work moving along briskly. Abundance of contract work indicated probability of high prices, and it was necessary to so prepare the design as to include all work possible and also be sufficiently flexible to allow omission of items of least immediate value if this should be found necessary. A portion of the upper end of the intercepting sewer system was, in fact, omitted but was constructed later as a WPA project.

Organization of the Danville Sanitary District involved securing signatures to a petition followed by holding an election to authorize it and it was not possible to hold the election before November 13. The city, therefore, in advertising for bids on November 2, ran the risk of the election not carrying. It did, and the administration was organized the day following and prepared an ordinance, which was voted on favorably on Dec. 6, authorizing the issuing of $192,500 of 3% bonds. Proposals for the purchase of the bonds were invited by advertising, letters and telegrams prior to the bond election and the bonds were sold at a premium of $3,696.

The low bidder on the sewer contract, which had been advertised by the city, refused to sign it on the basis



Layout of Danville treatment plant. Railroad embankment at left, levee in front and at right.

that it would be illegal to transfer it from city to sanitary district, and as a way out of the legal entanglements all the bids received Dec. 2 were rejected and new ones called for to be submitted Jan. 20, PWA having acquiesced in the extension of time for beginning construction. Only one bid was received for the treatment plant; but as this was from the previous low bidder and slightly below his original bid, award was approved by the PWA, and contracts signed for the sewer on January 30 and for the treatment plant on Feb. 4; the former to the Allied Bridge & Construction Co. of Chicago for $86,478.76 and the treatment plant construction to R. McCalman, Inc., of Danville for $213,432.57. These totals were based on the engineer's estimates of quantities. The final construction cost was $214,705.93 for the sewage treatment plant and $87,471.22 for the intercepting sewer, a total of $302,177.15.

Soon other obstacles presented themselves. Terms of the PWA grant and of the contracts called for completion of construction work by November 30, 1936. But deep frost remained in the ground until March 1, then came out rapidly and created a sea of mud at the treatment plant site; and this had hardly begun to dry when the Vermilion river inundated it. Although the flood subsided about March 15, active work could not be begun before the end of the month. By this time substantial strides had been made in the preparation of detailed working drawings permitting unretarded progress by the contractor.

Another difficulty arose, in that negotiations for a railroad siding into the plant for delivering liquid ferric chloride in carload lots failed to obtain one at an equitable cost to the Sanitary District, and the chemical feed equipment was redesigned to provide facilities for dissolving anhydrous or crystal ferric chloride and a storage tank for the solution.

Another—The first of the concrete piers in the settling tanks had just been constructed in August when the manufacturer furnishing the settling tank mechanisms was notified of a suit claiming infringement of patents by said mechanisms, which were ready for shipment. Fearing interminable delay, the engineers agreed to permit the substitution of mechanisms which were designed to avoid the claims of infringement, which required preparation by the manufacturers of detailed shop drawings and extraordinary care in examination of them by the engineers and in manufacture of the equipment. As a result, the mechanisms were not delivered to the plant until mid-December and the floors of the tanks could not be placed until after that. Then an early winter and increasing ground water levels delayed the work, and the settling tanks could not be completed until early February, 1937.

In view of the foregoing, the city obtained from the PWA an extension of the deadline set for the project, and placed in operation February 3, 1937, a well arranged and constructed treatment plant of which the Sanitary District and the engineers are, they hope pardonably, proud.

Description of the Plant

The sewer contract involved constructing approximately 8,000 ft. of 30″ and 18″ sewer, and 1,000 ft. of 42″ was included in the contract for the treatment plant. The intercepting sewer has a maximum capacity of 11.25 mgd where it connects to the 42″, and the latter has a design capacity of 20 mgd, allowing for future sewer connections. The treatment plant was designed on the basis of 50,000 people, the population forecast for 1955, with a nominal capacity of 4.5 mgd but designed to take a maximum flow at the present time of 11.25 mgd. Connecting sewers, plant piping and structures not readily increased in size or number were designed for what is considered the ultimate development of the plant.

The Vermilion river, into which the effluent is discharged, is very flashy, the flow varying from 13 to 4650 cfs, the normal annual variation of 7 ft. being almost equaled in as many hours at times.

The desire to take advantage of the large dilution factor and dissolved oxygen in the river during periods of high flow and the need for adequate pollution removal from the river during low flows, led to provision for chemical treatment of sewage. An economical balance was struck between effective sedimentation capacity, as regards plain sedimentation and chemical treatment, resulting in favorable first and annual costs.

The plant elements comprise a rotary mechanical screen; a 2-pass drag-scraper-type grit tank; a by-pass for the screen, grit tank and plant; a main building

General view of Danville treatment plant, looking south from the road embankment. Sludge beds are in the left background. The sludge tanks, sludge control chamber and sludge pumping station are shown in the central background, the sludge digestion tank being brick veneered. The flocculation tank and two settling tanks and the main building are in the right foreground.

with three floor levels, housing the sewage meter tube and equipment, the building heating plant, a drainage pumping station, chemical feed devices and chemical storage room, office and laboratory, also an elevator to serve the chemical storage floors; a 2-pass flocculation tank with total displacement equal to 15 minutes at nominal capacity; two circular settling tanks with total displacement equal to two hours at nominal capacity; a sludge digestion tank and a sludge storage tank, both equipped with floating covers, and each having a capacity of 75,000 cubic feet; a sludge control chamber sandwiched between the sludge tanks; a sludge pumping station which is connected to the sludge tank walls by means of short tunnels, having two floor levels housing the sludge pumps and meters, the digestion tank heating plant and gas control equipment; 40,000 square feet of open sludge drying beds separated into twelve independent beds; and, finally, the plant outfall.

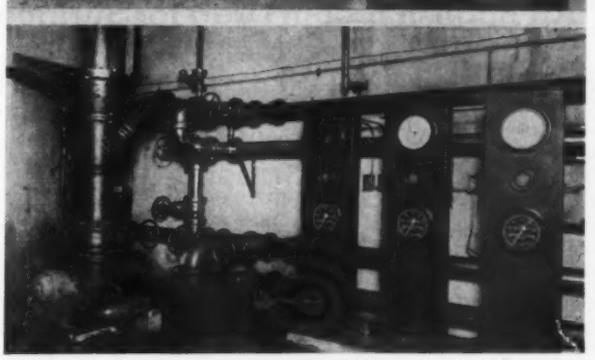
The mechanical sewage screen, grit tank, flocculation tank and settling tank mechanisms and the floating covers of the sludge tanks were specified with provisions for equipment of alternate manufacture so as to assure competitive bids for mechanical equipment. This necessitated preparation of alternate designs for structures to receive the mechanisms. The details for these were developed during the time working drawings were being prepared for the concrete structures. This was more or less true of the metering, pumping and chemical feed devices for which the detailed arrangements of piping were worked out following decisions as to the manufacture of equipment.

The sewage screen is a so-called "Comminutor," manufactured by the Chicago Pump Company, which likewise furnished the pumping equipment. The grit tank, flocculation and settling tank mechanisms were furnished by the Link-Belt Company. Pacific Flush-Tank Company furnished the floating covers for the sludge tanks. The meters are of Builders Iron Foundry manufacture and the dry chemical feed machines were manufactured by Omega. Proportioneers produced the iron feed devices to fit into the designed ferric dissolving and feeding system.

Operation of the Plant

The plant was operated on a plain sedimentation basis from February 3 to September 1, when chemical treatment was begun, and continued until November 4 on a more or less experimental basis. Some of the operating results are summarized in the accompanying table.

Alum was used during September at the average rate of 373 lb. per million gallons, from 673 lb. maximum to 251 lb. minimum. From October 29 to November 4 inclusive, ferric chloride and lime were used, at the average rates of 96 lb. and 185 lb. respectively per million gallons; ferric chloride doses varying from 73 to 145 lb. and lime from 168 to 209 lb. Although the periods of operation with chemicals were too brief for



Top—Grit tank mechanism; elevating screws at right. Bottom—sludge pumps, piping and meters in the basement of the sludge pumping station. The picture shows the southeasterly corner of the sludge pumping room. The southwest corner of the room is identical as to pumps, piping and tunnel to the wall of the sludge tank.

	Suspended Solids—p.p.m.			*5-Day B.O.D.—p.p.m.*		
Operation	*Raw*	*Effluent*	*Percent Removed*	*Raw*	*Effluent*	*Percent Removed*
Plain sedimentation, flocculator by-passed	241	69.6	71.0	243	137.4	43.3
Plain sedimentation, flocculator in use	210.1	56.6	73.0	200	104	48
Chemical treatment with alum	235	43.6	81.4	201	77	61.5
Chemical treatment with ferric chloride and lime	188.8	43.5	76.9	177	60.7	65.7

conclusive results, these indicated the potentiality of alum as a flocculent.

Operation of the flocculator is routine procedure at Danville. The flocculator consists of a 2-pass tank, each pass equipped with paddle agitators rotating about an axis parallel with the flow of the sewage. Paddle agitation is preceded by air agitation which is used only intermittently, with plain sedimentation, to avoid accumulation of sludge in the air mixing compartment. Plain sedimentation removal of suspended solids and of 5-day B.O.D. is shown in the accompanying table, with and without the flocculator in operation. Plain sedimentation without the flocculator was in use from August 15 to 21, which again is too short a period for conclusive results; but it is of interest that the use of the flocculator appears to improve the removal of suspended solids and 5-day B.O.D.

Good oxygen balances are being maintained in the Vermilion river. During the month of September, for example, dissolved oxygen in the river water averaged 7.2 ppm above and 5.4 ppm below the treatment works, the minimum with the river flowing 46 cfs, being 2.6 ppm and 5.2 ppm below and above the plant respectively.

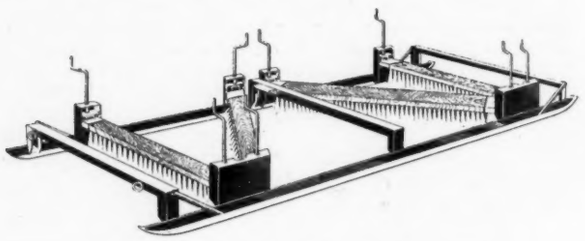
About 40,000 cubic feet of gas is produced in the digestion tank per day, approximating 1.5 cubic feet per capita for the connected population and upwards of 17.0 cubic feet of gas per pound of volatile matter added to the digestion tank. More than 40 tons of solids are being removed monthly from the sewage treated. The gas is used to fire the boilers for heating the sludge digestion tank and the main building and to operate the laboratory refrigerator, the excess being disposed of in a waste gas burner.

The project was administered by the Sanitary District Board, comprising J. E. Epler, president, G. K. Hooton and T. H. Carson. At the close of the construction period Mr. Epler resigned to assume the managership of the District, Mr. Carson replacing him as president, and George Fox was inducted into Board membership. F. O. Sullivan is chemist at the sewage plant.

Greeley & Hansen were engineers for the Sanitary District, U. K. Sick acting as resident engineer for them. Mr. Sick was assisted by W. M. Fairhall at the treatment plant, and F. A. McCann on the sewer work.

An English Broom Drag for Surface Treatment

This description of the broom drag and the methods of its use are abstracted from an article in *Highways and Bridges*, an English publication. The drag shown has a welded steel frame with "T" section steel runners, and is 16 feet long by 7 feet wide. It has four brooms, the end ones being set at right angles to the runners and the middle ones diagonally. Screw handles on the brooms provide the means of adjustment, while the apparatus is either stationary or moving. The drag works in either direction, and being moderate in weight can be easily drawn by a light motor truck, to which it is attached by chains. If necessary it may be guided by a handle inserted into one of the pipe sockets fitted into each of the four corners for this purpose.



An English broom drag for use on surface treatment

Since it moves on runners much longer than the wheelbase of any moter vehicle, and therefore straddles and eliminates depressions, it provides a good riding surface.

The makers describe the method of using as follows: After the existing surface has been given a light tack coat of emulsion, a course of stone chippings, spread on the road dry, is alternately broom-dragged and rolled until a smooth and closely-compacted surface is obtained. The course is then watered, and immediately afterwards semi-grouted (preferably sprayed) with Emoleum or other suitable quick-breaking emulsion, which must be of low viscosity to penetrate the aggregate, coating every particle thoroughly.

The next stage is to apply grit and thoroughly roll. For a heavier carpet, in order to obtain still better results, the grouting is followed by a liberal covering of chippings which are rolled and broom-dragged so as to improve the evenness of the surface and correct any secondary irregularities.

Thereupon emulsion is sprayed as before, and either fine or coarse grit applied, rolled, and again broom-dragged.

Fellowships in Traffic Control at Yale

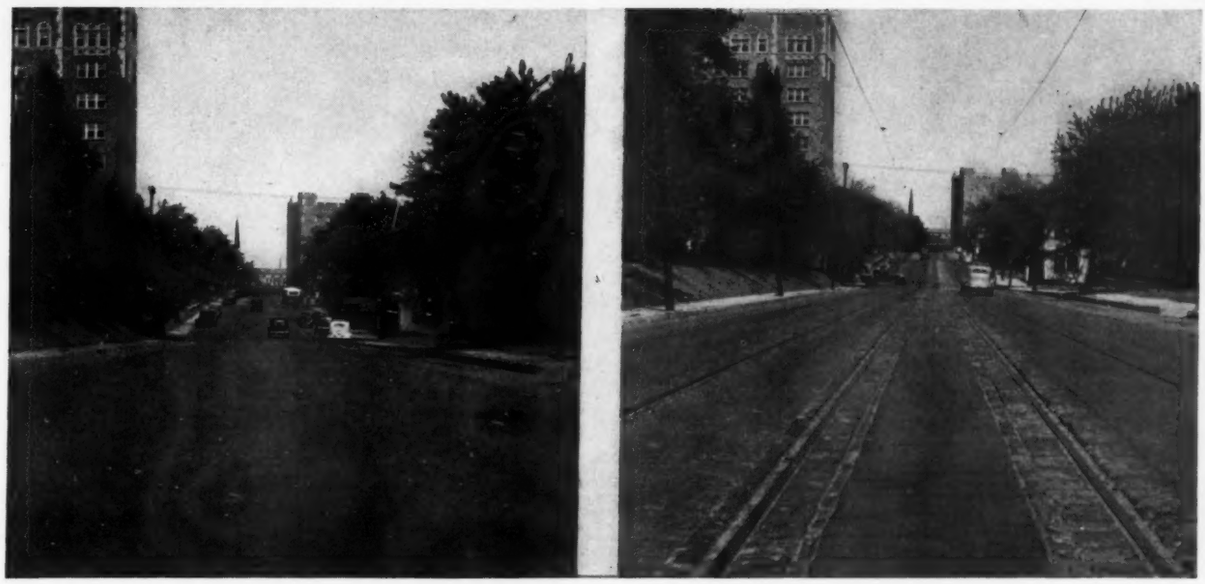
Fifteen fellowships are offered by the Bureau for Street Traffic Research of Yale University, giving opportunities for obtaining a broad foundation in the techniques of traffic control, with research facilities for concentrating on a specialty for thesis subjects. The course will require the students' time for approximately fifty hours a week for eight months. The fellowship give full tuition, $800 for living stipend and $200 for travel and field investigation.

Four courses are given—(1) Principles and (2) Problems of Street and Highway Traffic Control; (3) Planning and Design of Traffic Facilities, and (4) Economics and Administration of Traffic Control. The program is made possible through gifts from the Automotive Safety Foundation and personal gifts of Alfred P. Sloan, Jr.

Applicants for fellowships must have an engineering degree representing four years' work in an accredited college or university and be not more than 30 nor less than 23 years old. Those now holding positions in fields related to street traffic control must secure leave of absence for the duration of the course (Sept. 26, 1938 to June 1, 1939) so that they may return to their positions after its completion. Application forms can be obtained from Maxwell Halsey, Associate Director of the Bureau for Street Traffic Research, 315 Strathcona Hall, Yale University, New Haven, Conn., and be returned on or before June 1.

Liability for Defects in County Line Bridges

The Georgia Court of Appeals holds (Wasden v. Jefferson County, 193 S. E. 116) that the provisions of the Georgia statute making counties primarily liable for injuries caused by defective bridges, whether erected by contractors or county authorities, is not applicable to a bridge erected over a water course which divides one county from another. Liability for defects in county line bridges attaches only under another statute for failure of the county to take a sufficient bond from the contractor.



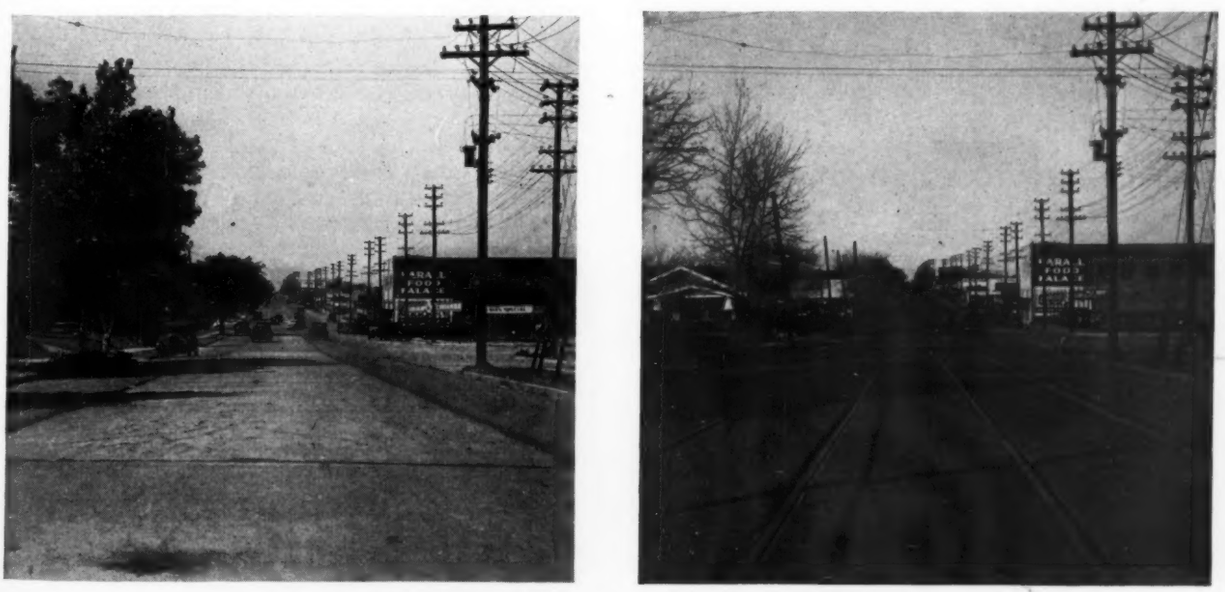
Main St., north of 15th, Tulsa, showing improvement by removing old tracks.

Forty Miles of Car Tracks Removed from Tulsa's Streets

By M. C. SHIBLEY
City Engineer of Tulsa, Okla.

TULSA, Oklahoma, last year removed from its streets approximately forty miles of street car lines and repaved the areas, the city furnishing twenty-five per cent of the total cost of the job and WPA the balance. This project, which cost approximately $500,000, was of greater interest to the public and required closer supervision by the Engineering Department than any other public works project carried out in 1937.

The streets cleared of these obstructions had been paved, some with brick, some with asphalt and some concrete; and in each case they were repaved with the same kind of material. Trolley poles and wires were removed at the same time, adding to the improvement. All of the rails removed became the property of the city and were sold to the highest bidder, bringing prices ranging from $5.25 per ton to $12 per long ton. Brick removed were sold, some uncleaned, on the job, at $3.00 per thousand; others were cleaned by WPA forces and sold for $4.50. The poles and trolley wires were sold



Lewis Ave., Tulsa. Left picture shows replacement with concrete.

M. C. Shibley

in place at quotations received from interested parties, each to the party making the highest lump sum bid. This procedure was followed in handling the overhead materials so as to avoid using skilled labor (linemen, etc.) in removing them and paying high workmen's compensation.

When the work was completed the city found that its receipts from the sale of rails and reclaimed bricks would amount to approximately 40% of the total cost of the materials. The balance of the materials and skilled labor requirements were furnished from appropriations set up in our annual budget and from the Street Department.

In the track removal we used all government labor except in placing the asphalt, on which city forces were used exclusively.

In removing track on brick-paved streets, we removed all brick with the rails and built up a concrete base for the new brick paving on the old street car base. On concrete-paved streets, the center strip was replaced with concrete; and with asphalt on asphalt-paved streets. Necessary repairs were made to the pavement on each side of the center strip at the time the center strip was replaced.

The work was planned so as to avoid as much as possible any inconvenience to the merchants and the traveling public. This presented many problems, both major and minor, to avoid handicapping merchants in their sales, theatres during afternoons and evenings, and hotels at night. Very few streets were shut off from traffic, and when this was necessary only one block at a time was barricaded. Through the business district, where there were double tracks, work was carried on simultaneously on both. Wonderful cooperation was given by the Police Department and by the citizenship in general. No major accidents occurred during the construction either to the traveling public or to the WPA and city employees engaged thereon, although the rails from approximately twenty miles of track were loaded by hand on flat cars.

Of the total cost of approximately $500,000 in federal and city funds, the equipment rental and cash participation of the city amounted to approximately $140,000.

Use of Powdered Asphalt in Low-Cost Road Work*

By PETER DRAPER

Madison County Road Supervisor, Anderson, Indiana

WE first used powdered asphalt in 1937; therefore, I am not wholly prepared to give final conclusions. Naturally, we were favorably impressed by its many claimed advantages.

The staff of the contractor was augmented by field engineers of the company, who surveyed the work to be done some time before it was started. The aggregate was inspected both on the road and in the pits. Samples were taken and analyzed at the refinery laboratory at Robinson, Illinois, and definite formulas determined to make a first-class bituminous mix. The correct amount of aggregate was placed on the road and the work was done with modern equipment and experienced men, under the direction of the refinery field engineer.

With the powdered asphalt, we used our own native gravel, of which we have several deposits in our county. This gravel carries a considerable amount of sand, which gives us a very dense waterproof top.

We first coat the aggregate with the liquid asphalt, which easily mixes with this finer-graded native aggregate; then the asphalt in powder form is applied in the proper proportions through an ordinary lime spreader or calcium drill. Then the windrow is bladed until the two asphalts are thoroughly combined. After laying out the road mix, we do not wait a day or two for it to set up, for the reason that there are no dissolving liquids to evaporate in order for the asphalt to become hard. This being the case, we have an asphalt cement, together with finely graded aggregate, which seems to be a perfect combination.

In portland cement concrete, we require a very densely graded aggregate, in order to make the cement do its best work. The same thing is true of black top—the open spaces between the pieces of aggregate must be filled with something, either asphalt or sand particles. Having these voids filled with the sand portion of the aggregate makes the mat waterproof throughout the entire thickness. This eliminates the requirement of sealing the top after the traffic has set the original mat. Of course, when figuring black top, any sealing, whether done the first or second year, should be considered as part of the original cost.

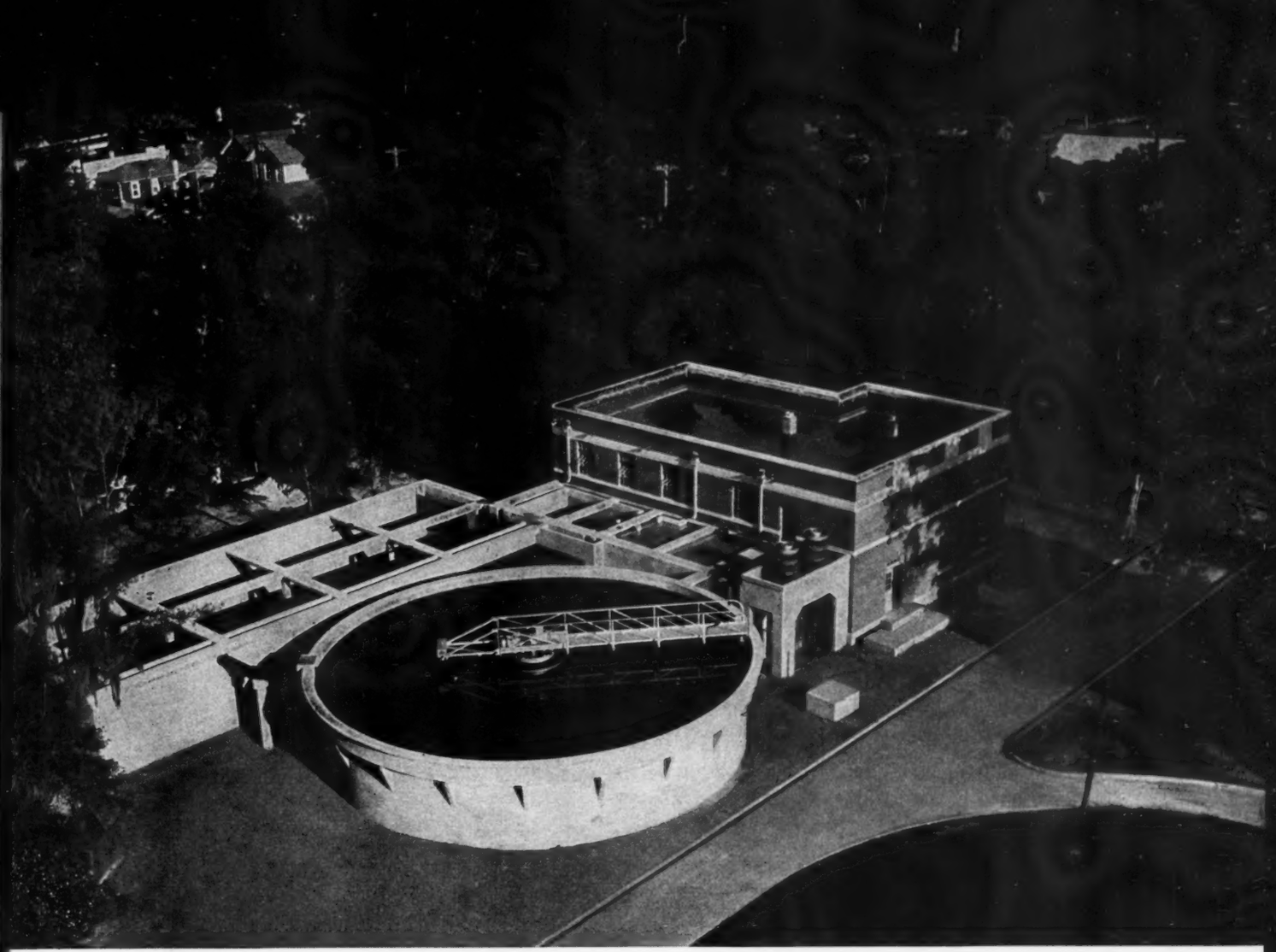
The use of powder has several advantages, among the most important being the predetermining of the asphalt cementing quality. That is, by the use of more powder, or less powder, you can predetermine just the consistency required for the type of job or the type of aggregate involved. This is a very important feature.

This material also has advantages in making patching mixture. By using a small concrete mixer, we premix our patching material, using the two asphalts. first putting the liquid asphalt and aggregate into the mixer, allowing it to turn a few times until the aggregate becomes coated, then adding the powder (using a bucket marked so that we use the same amount each time without having to weigh each batch. We also measure our aggregate and oil by a marked container). A few more turns of the mixing drum and the material is dumped out onto a sheet-iron floor under the mixer, in order to make shoveling easier. We either haul it to the job and use it immediately, or put it in stock-piles for future use.

The mixture does not seem to set up or become hard until it has been compacted by either rolling or traffic, because it contains no volatile material. Being able to predetermine the asphaltic content, thereby making the patching mixture either a soft pliable mass or a harder material, we have found that we can patch any of our roads with the same materials, either our concrete roads with the harder mixture, or other types of surfacing with the softer, more pliable mixture.

When making large patches, we use our roller in order to make this repaired area as smooth as the existing surface; but where we are filling small holes, we use a tamp or let traffic iron out the patches. We are of the opinion that we get about as good results whether pre-compacted or compacted under traffic. By using the finer aggregate, we are able to feather the edges of the patch, or to make a thin skin patch, sealing the "alligator" cracks that may occur where the base is weak.

* A paper presented at the Twenty-fourth Annual Purdue Road School, January 24-28, 1938.



A striking view of the new St. Augustine water softening plant

St. Augustine Completes New Softening Plant

By DR. A. P. BLACK and CHAS. H. STARLING

Professor of Chemistry, University of Florida, and Resident Engineer Robert & Co., Inc.

WHEN, in 1513, Don Juan Ponce de Leon sailed into Matanzas river and dropped anchor at the site of St. Augustine, he believed he had found the fabulous Fountain of Youth and its miraculous water. Later visitors to St. Augustine have learned that rejuvenation can be found in the sunshine and climate, but, until the present time, the search for a satisfactory water has gone on.

The need for a soft water was first acutely realized in the latter part of the 19th century when Henry M. Flagler began his development of the Florida East Coast and started the southward trek of tourists. Many deep wells were driven in the hope that a naturally soft water could be found, and, in spite of its many drawbacks, artesian well water has continued in use by the municipality for its water supply.

Aside from hardness (average 30 to 40 g.p.g.), the artesian supply was unsatisfactory since, due to increasing hardness, salinity and diminishing flow, it was necessary to abandon the existing wells and drill new ones after several years' use; and in 1925 it was decided to develop a surface supply, and eight 12-inch gravel-wall wells were sunk along a low ridge about two miles southwest of the city. This supply was considerably softer than the artesian water but was generally unsatisfactory due to a high organic color and, after several months use, was abandoned except for fire and emergency purposes. (Incidentally, it may be said that, although this development may have failed to accomplish the intended purpose, its cost has been many times justified when fires have threatened the old historic buildings and landmarks which certainly would have been destroyed had it not been for this supply.)

When funds for such projects were made available by the Public Works Administration, the city secured a loan of $95,000 and a direct grant of $77,000 for the purpose of building a softening plant. It had been determined that the water from the existing surface wells could be successfully treated by aeration, lime softening, primary clarification, secondary coagulation, settling, recarbonation (if necessary), filtration and stabilization, and that the existing surface wells with the addition of three new ones, could furnish the required supply of two million gallons per day.

Supply.—The new wells are of the gravel-wall type, approximately 90 feet deep with 24-inch gravel walls and 10-inch screens and casings, and are located adjacent to and in line with the old surface wells. The old well pumps were discarded and replaced with new deep-well turbine pumps of 200 g.p.m. capacity, and identical with those installed in the new wells. Each of the pumps discharges directly into the raw water supply line to the plant, so that all or any number of the wells may be used simultaneously. The pumps are controlled from an oil circuit breaker located at the plant.

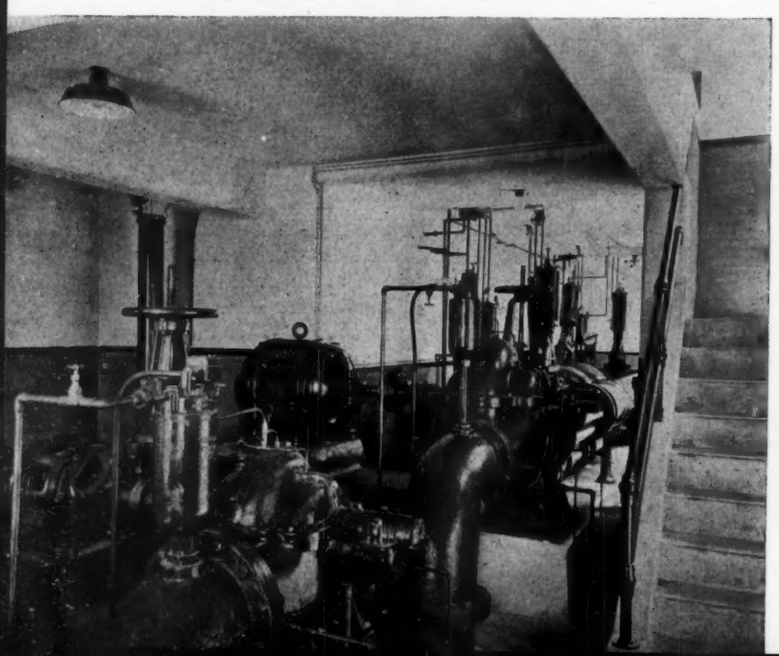
Plant.—The new softening plant is located on the west side of the city, adjoining the site of the old pumping station, clear water reservoir, and elevated tank, all of which, being in good condition, are utilized in the new development. The filter building is a steel frame structure on concrete foundations with concrete block and brick walls and cast stone trim; the construction is fire-proof, and the architectural effect very pleasing. The first floor of this building includes the pump room, pipe gallery, and recarbonator room, while on the second floor are filters, operating gallery, laboratory, chlorinator room, and chemical storage and feeding.

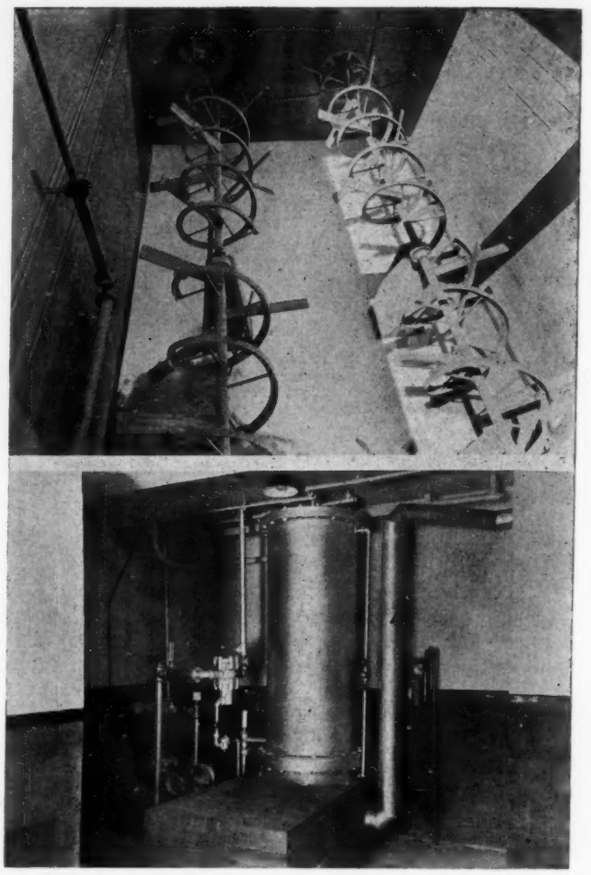
Back of the filter building are located the mixing chambers, clarifier, settling basin, and recarbonation chamber; built into a continuous structure adjoining the filter building and easily accessible from walkways leading from the chemical storage room.

Operation.—Water enters the plant through Infilco Multi-cone aerators, installed at one end of and above the mixing chamber so that the discharge from the aerators flows by gravity to the mixers. Two aerators are provided and may be used singly or in parallel.

The primary mixing chamber is a rectangular concrete basin providing 30 minutes detention at the normal filter rate of 2 m.g.d. Chemicals are fed at the point of discharge of the aerators and are mixed by means of two parallel spiral mixers which run lengthwise of the basin and are motor driven through a variable speed reducer and chain drives. The mixing speed can be varied by means of the speed reducer or by changing the setting of the mixing paddles. The effluent of the mixing chamber flows through a 16-inch underground pipe to the center of the clarifier.

Filter gallery; filter piping at right and transfer pumps with automatic primers in center.





Above, mixing chamber and type of mechanical mixers; below, recarbonation equipment.

The clarifier is a circular concrete basin providing three hours detention and is equipped with a Link Belt Circuline sludge collector for removing settled sludge. The flow through the clarifier is radial from the center diffuser to a weir and flume around the periphery of the tank. The collected sludge may be discharged by gravity into a storm drain or a part of it may be pumped back into the mixing chamber to be mixed with the untreated water.

From the clarifier the water moves into the second mixing basin, where the coagulant is added and the floc conditioned for twenty minutes, a spiral mixer running lengthwise of the basin being provided for this purpose. An additional three hours of settling is then provided in a rectangular concrete basin through which the water flows at a velocity of approximately 0.45 foot per minute. After recarbonation (if necessary) the water passes to the filters.

The recarbonation chamber is at the effluent end of the settling basin and is equipped with a grid of perforated cast iron pipe in the bottom through which carbon dioxide is diffused into the water. The carbon dioxide is obtained by burning manufactured gas in a furnace, and is scrubbed and dried before going to the blower for delivery into the diffuser grid.

The two filter units are the rapid sand type, each unit having a capacity of 1 m.g.d. The underdrains are cast iron and the wash troughs are built-in-place concrete. All filter valves are hydraulically operated and are controlled from the operating tables directly in front of the filters. Recording rate-of-flow and loss-of-head gauges are mounted on the operating tables.

The authors: Prof. Black (left) and Mr. Starling.

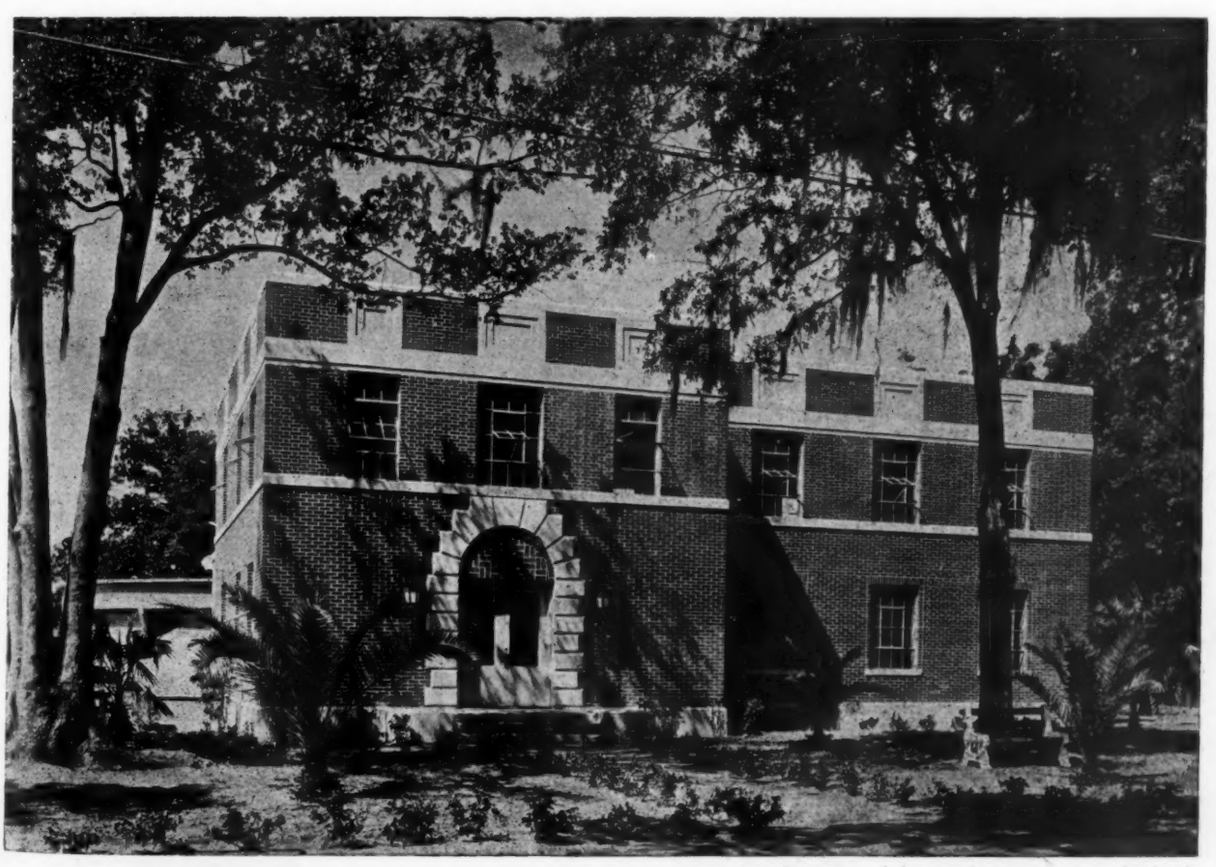
The filtered water discharges directly into a 60,000-gallon clear well located beneath the building.

In the pump room on the ground floor of the filter building are two transfer pumps of 1,400 g.p.m. capacity each, which deliver the water from the clear well to the existing 1,000,000 gallon reservoir which is some 20 feet above the clear well. These pumps are automatically controlled from float switches in the clear well and reservoir. In this room also is the wash pump, which is fed directly from the clear well, has a capacity of 6,000 g.p.m., and is controlled from a manual starter on the operating floor.

Chemical Feeders.—The alum, soda ash, and carbon feeders, which are of the dry feed type, are located in the chemical feed room and discharge into the mixing basin through short runs of pipe. Lime is slaked and fed from the limehouse—a reinforced concrete structure approximately 15 feet square and 30 feet high located on a railroad siding about 200 feet in the rear of the filter building. Lime is unloaded from the cars directly into the hopper of a Link Belt elevator and is discharged into the storage compartment in the upper part of the building, from which it is fed by gravity through a weighing batcher to the feeder and slaker on the first floor. The slaked lime is mixed with excess water and pumped to the point of application at the mixing chamber.

Quality of Raw Water.—As has been previously indicated, the water from the artesian wells in use at the time the plants was built was very undesirable in several respects. In the first place, the hardness was excessive, varying from 30 to 40 g.p.g., most of which was non-carbonate hardness. The salinity was high, total solids exceeding 900 parts per million and the content of both sulfates and chlorides was such as to impart a distinct salty taste to the water. Hydrogen sulfide is usually present in waters of this type in Florida and this supply was no exception. It was not entirely removed by the aeration formerly provided and the water reached the consumers with a distinct and disagreeable taste and odor. Also, the water was highly corrosive. These undesirable qualities had resulted in the widespread use of bottled and distilled water in hotels, restaurants and homes and it was conservatively estimated that the expenditure for such waters amounted to many thousands of dollars annually. To make matters worse, there was a gradual increase in both salinity and hardness so that, after a few years, the water from a group of wells would become so objectionable that they would be abandoned and others drilled.

Quality of Water from the Shallow Wells. — The shallow wells, on the other hand, yield a water which is much softer, averaging 21 grains per gallon, 19 grains of which is carbonate hardness and only 2 grains



Front view of filter building showing details of main entrance.

incrustant hardness. Magnesium is unusually low, even for Florida waters, being only 4 p.p.m. Sulfates and chlorides are likewise low, averaging 30 and 44 p.p.m. respectively. Iron is high, varying from 2 to 3 p.p.m. and organic color ranges from 50 to 100. No hydrogen sulfide is present.

Difficult Treatment Problems Involved.—The economical removal of organic color from a water highly buffered with bicarbonate alkalinity presents a problem of unusual difficulty. The precipitates produced in the softening reactions will usually effect some reduction in color, in this case reducing it to about 35, both in jar tests and in plant trials. The addition of alum with the lime in doses up to 4 grains per gallon produced little additional effect, the resulting color of the treated water being about 25, which was not considered satisfactory. This was to be expected, since it is impossible, due to precipitated calcium carbonate, to lower the pH into the acid range under such conditions. Jar tests indicated that the water should first be softened and settled, after which secondary coagulation with alum would lower the pH to a point where color removal was practically complete. In such cases, color removal results from the combination of the positively charged trivalent aluminum ion with the negatively charged color colloid, the result being the formation of a "color floc." Adsorption likewise plays a part in the process.

Outline of Treatment Used.—The water is aerated, which oxidizes practically all of the iron, after which it is softened by the addition of 13 grains per gallon of unslaked lime. The lime is slaked in a solution-type slaker at a temperature of about 160° F. It was soon found that, due to the relatively long period of time elapsing between closing down the plant at night and starting operations the following morning, the lime slaker would cool to such an extent that slaking would not start promptly. Consequently, each morning considerable time would be lost in heating the slaker and adjusting the feed, and treatment could not be kept uniform. This was corrected by insulating the slaking chamber so that heat would be retained overnight and no further trouble was encountered.

No coagulant is added with the lime in the first mixing basin. After 30 minutes mixing, the water is settled for 3 hours in the clarifier. Coagulant is then added and it passes to the second mixing basin were the floc is conditioned for 20 minutes at a velocity of about 0.75 foot per second. At present about 3.5 grains of "blackalum" is being used as the coagulant. Jar tests indicate that the use of sulfuric acid to lower the pH will, as would be expected, materially reduce the dose of coagulant required, and plans are now being made to try out this treatment in the plant. At present the pH of the water in the second mixing basin is about 6.8, which is believed to be too high for best results.

Stabilization of Filtered Water.—Since the filtered water has a residual alkalinity of only 35 to 40 p.p.m., and a pH of approximately 7.0, it is necessary to stabilize it in order to prevent corrosion of the distribution system. For this purpose about one g.p.g. of soda ash is added to the water as it passes from the filters to the clear well, using a dry feed machine. With good coagulation, this does not appreciably increase the residual color of the filtered water. Due to the condition of the mains resulting from the corrosive action of the old artesian supply, it has been thought desirable to maintain the pH above the equilibrium curve and deposit an egg-shell coating of calcium carbonate over the old incrustation. This is being accomplished by adjusting the pH at 8.6 to 9.0 depending upon the final alkalinity. Soda ash is used instead of hydrated lime since it is desired not to increase further the hardness of the water.

Quality of Treated Water.—The finished water has a hardness varying usually between 65 to 75 p.p.m. and is never allowed to exceed 85 p.p.m. or five g.p.g. Residual color varies from 5 to 8 and never exceeds 10. Complaints from consumers result if this figure is exceeded.

The reaction of the public toward the new supply was immediate, widespread and most favorable. Resolutions of commendation were passed by various civic organizations and other groups, one of the most unusual received being signed by all the waitresses in one of the city's leading restaurants.

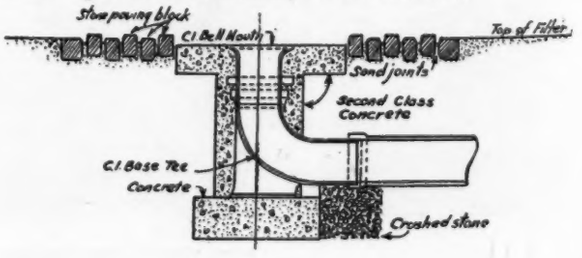
Cost of Treatment.—The cost of the chemicals used in the treatment has averaged $15.72 per million gallons of water during the first four months operation of the plant, which is considered quite moderate in view of the treatment used. Consumption of water has increased steadily and at present the plant is treating almost exactly one million gallons per day, or 25 to 30% more than was formerly sold.

Chemical Laboratory.—Realizing the vital importance of careful chemical control to the efficient and economical operation of a plant of this type, a large, well lighted, and well furnished laboratory has been provided. It is well equipped not only for making the usual routine tests necessary for control but also for the complete chemical analysis of raw and treated water and equipment for bacteriological control will be added shortly. Each member of the operating staff is exceptionally well trained for his duties and under their direction the operation of the plant has been consistently uniform and satisfactory.

The plant was designed by Robert and Company, Inc., architects and engineers of Atlanta; C. H. Starling was the resident engineer in charge of construction. Chemical control and chemical operation of the plant is under the direction of Dr. A. P. Black, Professor of Chemistry at the University of Florida. R. M. Johnson is the chemist and chief operator of the plant. Eugene Masters is City Manager and Walter B. Fraser is Mayor-Commissioner. The general building contractor was G. W. Hessler of Jacksonville; filter equipment and piping contractor was Municipal Service Co., Kansas City, Mo., which company also furnished the spiral flocculation; filter controllers and gauges and meters were furnished by Simplex Valve and Meter Co.; and filter operating tables and chemical feed machines by International Filter Co.

Applying Sewage to Sand Beds

The application of sewage to sand filters without eroding or disturbing the surface of the sand is often a problem. Wooden troughs float out of place, rot, absorb sewage and give off odors and are otherwise unsatisfactory. The accompanying illustration shows a method of application that eliminates most of these objections. This came to us via L. L. Langford of Pacific Flush Tank Co., from the Division of Sanitation of New York State Department of Health, we understand.



The Editor's Page

Diversion of Water Revenues Is Unfair and Unsound

Much has been said by and for highway officials in condemnation of the growing practice of diverting gasoline and automobile taxes to purposes other than road construction and maintenance. Not so much protest has been published against similar diversion of water revenues. That such diversion is not so uncommon as it should be is disclosed by E. B. Black, consulting engineer of Kansas City, Mo. He finds that several hundred cities are diverting water revenues to general administrative purposes; the total so diverted running to millions of dollars annually.

A survey of Kansas municipalities showed that of 500 municipally-owned utilities in the state, 150 of them in 1936 contributed $1,387,200 from their revenue to other city funds, and rate payers thus relieved general taxpayers of the burden of raising that amount in taxes. On the other hand, however, 109 water plants and three combined water and electric plants received $274,435 from general tax funds, and thus deficits in operating revenues were saddled on general taxpayers.

It is the consensus of water men that municipal water departments should be placed on a business basis. They should be self-supporting and their rates should be reasonable. Rate payers to those plants that contribute revenue from collected rates to other city funds are entitled to rate reductions. The rates of those water utilities receiving money from other city funds for the payment of water works obligations should be increased —no matter what theory may be held as to the basis of equitable rates.

The principle in the two cases is different. In the case of highways, there is a moral obligation to spend for the benefit of automobilists the funds extracted from them as a class. In the case of public utilities, economists quite generally agree, we believe, that each should finance itself independently of other municipal receipts and expenditures. Only thus can both consumers and tax payers get a square deal, and economy in operation of the utility be encouraged.

Payers of water rates and gasoline taxes have been "easy marks" for revenue raisers. It is time they demanded and secured a square deal.

Local Control of Highway Funds

Some of the highway planning surveys now being conducted by 45 states in cooperation with the U. S. Bureau of Public Roads (few of which have yet been completed) have shown that highway funds appropriated by the states to counties or smaller political units have, in some cases, been spent for purposes other than highway work. The remedy proposed by some is to discontinue such appropriations, and have the funds spent by state appointees who live outside the counties whose funds are placed in their charge—the further outside the better.

Their arguments do not impress us. It is no secret that several of the states have done a fine job of diverting state highway money for other purposes; what reason is there for thinking they would be more ethical in spending county highway funds? Most local communities, no matter how small, have some able men in them—as able and honest and certainly as well informed in local conditions as any one likely to be appointed to the job from outside. In the four decades we have been publishing this magazine we have acquired some familiarity with the problems of counties, towns and cities, and with the personnel and methods they employ on their public works; and we have learned a lot from and entertain the highest respect for these "small-town" engineers. Of the ten thousand or so of them, the great majority are planning, constructing and operating public works with ability and economy, and with more knowledge and consideration of local needs and conditions than any outsider would have.

As for diversion or ineffective use of highway funds, whose neck can indignant gas tax payers jump on quickest and hardest, their fellow citizen or some stranger up at the state capitol?

Yellow Fever and Sanitary Engineering

Aedes aegypti mosquitoes have been thought, since the days of Gorgas, to be solely responsible for the spread of yellow fever, and our own South has been freed from this terror by this knowledge. Now the Rockefeller Foundation, in its annual reports, shows that this is not the whole truth. In the jungle depths of both South America and Africa, where no *aedes aegypti* exist, there appears to be a permanent reservoir of infection. This new picture of yellow fever is a dark one. But it is not hopeless, because it has been demonstrated that control of these mosquitoes in civilized areas will control the disease.

The fact that there are means of transmission other than by the yellow fever mosquito does not lessen the importance of mosquito control; paradoxically, perhaps, it increases the necessity for such work, especially in those areas within striking distance of these reservoirs of infection. Moreover, with the development of rapid transportation by airplane, our own cities are brought so much closer to danger. In most cities, North and South, there are plenty of *aedes aegypti*, the familiar mosquito of the rain water barrel; and how many days travel is it now by airplane from the Amazon to the Mississippi?

Few perhaps can remember the ravages of yellow fever in our own cities—Memphis, New Orleans, Philadelphia and others. If our readers have a little spare time, let them go to the public library and read of those conditions. Communications cut off by shotgun barricades; 40% of the population dead; commerce, trade, food supplies and medical aid almost totally absent. Our hat is off to the sanitary engineer for eliminating this scourge; but eternal vigilance is still the price of liberty from it.

F. E. Peterson

Solving a Storm Drainage Problem in DeKalb, Ill.

By F. E. PETERSON
Commissioner of Public Works of DeKalb

FOR many years the city of De Kalb, Ill., has needed more adequate drainage, some of the existing sewers being inadequate in both size and grade and a large portion of them consisting of common field tile.

The city is divided into 14 drainage areas by the natural topography, all draining toward the Kishwaukee river, which flows north through the city near its west corporate limit, then east along the north boundary. All the outlet storm-water sewers discharge directly into this river or into ditches which terminate at it. Of the drainage areas, that known as No. 2, the greater part of which constitutes the commercial section of the city, presented the most pressing problem.

Area No. 2 contains about 176 acres, and extends from Ninth St., where it is about a block wide, west past Eighth St., etc., to First, Lincoln, Park to John St., which parallels the river about 300 ft. from it and is separated from it by private land. Locust St. runs west through approximately the center of this area, and receives all the run-off from it, the northern slope being steep. This topography and the high degree of imperviousness of the business area, brings large volumes of storm water to Locust St.

About thirty years ago a 24″ vitrified pipe storm sewer was laid in Locust St. from Fourth to John St., a short distance south along John and then west across private land to the river. I believe that this sewer served this portion of the city properly at that time, but as paving of the streets and construction of buildings increased the imperviousness of the tributary area, the run-off increased until it exceeded its capacity. Also, even before the construction of the storm sewer east of John St., a private driveway leading from John St. to the river had been used to carry off surplus surface water which the sewer could not carry, with the consent of the owner of the property. This driveway is of concrete, 7′ 5″ wide with curbs on the sides, laid at a grade of 0.8%.

In 1931 residents in the vicinity of John and Locust Sts. complained of flooding after each severe rain storm and, under instruction by city council, the writer made the necessary surveys and recommendation for a method of relief. A contour map was prepared from elevations on file supplemented by others needed; the locations and elevations of all existing storm sewers and catch basins in area No. 2 were determined. Also estimates were made of the relative imperviousness of the various areas, the areas being determined of all roofs, driveways and pavements, which were considered to have an impervious factor of .90, and of all lawns, which were assigned an impervious factor of .10.

It seemed desirable to carry the Locust St. sewer straight to the river across private property, and an easement was secured from the owner of an 8 ft. strip west from John St. to the river at a cost of $255. In this strip a 36″ sewer 336 ft. long was constructed from

Computations for Designing De Kalb Storm Sewers

Area	Terminates	Areas (Acres)	% Imp.	C	CXA	Total CA	RI	Q Cfs Req'd	Size Req'd	Slope	V	Present Size	Sewer Q	Sewer V	Add. (a) Size Req'd	Size Used	Length	Inv. Upper	Inv. Lower	V
A	Fourth & Locust Sts.	20 @ .90 = 18.0 15 @ .10 = 1.5	56	30	.65	22.8	22.8	1.45	33.0	24″	.0235	11.0	15″	9.5	7.6	21″	21″	389′	89.50	80.50	10.0
A-B	Third & Locust Sts.	54 @ .90 = 48.6 50 @ .10 = 5.0	52	46	.67	70	70	1.00	70.0	39″	.008	8.5	24″	20	6.5	30″	30″	807′	80.50	74.00	7.5
C	First & Locust Sts.	20 @ .90 = 18.0 10 @ .10 = 1.0	63	48	.75	22.5	92.5	1.00	92.5	39″	.0124	11.0	24″	25	8.0	33″	30″	426′	74.00	68.00	10.0
																	36″	489′	68.00	62.80	10.0
D	Park Ave. & Locust St.	10 @ .90 = 9.0 20 @ .10 = 2.0	37	49	.64	19.2	111.7	0.98	109.5	39″	.0107	13.5	24″	18	5.6	36″	36″	537′	62.80	57.00	10.0
E	John & Locust Sts.	2 @ .90 = 1.8 10 @ .10 = 1.0	24	50	.57	6.8	118.5	0.98	116.1	48″	.005	8.0	24″	25	6.2	42″	(b) 36″	336′	57.00	55.30	7.0

$V = \frac{2000}{1} I \sqrt{S} = 2000 \times .52 \sqrt{.005} = 73$ ft. per min. Formula—H. E. Babbitt "Sewerage & Sewage Treatment."

*$t = \frac{}{V}$ = time of concentration = $\frac{3400}{73}$ = 46 min. for Area A-B terminating at Third & Locust Sts.

(a) For Area C—30″ constructed between First St. & Linden Place. Slope = .0142
For Area C—36″ constructed between Linden Place & Park Ave. Slope = .0107

(b) Private driveway in low place on John St. between Lincoln Highway & Locust St. used as Spillway for overflow. Grade of spillway 6″ above grade of street, and slopes toward river. Any surcharge from 24″ will discharge through spillway. Use of 36″ instead of 42″ reduces cost of construction. Driveway (spillway) has curbs on sides and is 7′ 5″ wide.

Values of C and R taken from "Rational Storm Drain Design Practice in Los Angeles." PUBLIC WORKS, June, 1934.

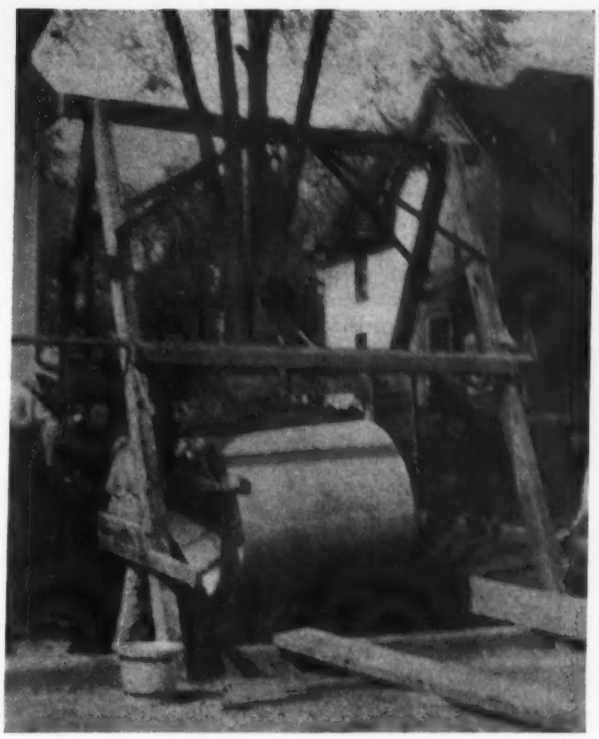
Imp. = Imperviousness
C = Coefficient of Run-off
Q = Discharge in Cubic Feet per Second
V = Velocity in Feet per Second
RI = Rainfall Intensity

the river to the manhole at the intersection of John and Locust Sts. and there connected with the existing 24" sewer; also 50 ft. of 8" vitrified pipe was laid as catch-basin connection, and two manholes built and a bulkhead at the outlet; but no more sewer was constructed at that time due to lack of funds. For this work, sewer pipe and other materials were purchased from the lowest bidders, $1,158.73 being paid for the pipe and $106.75 for other materials. Labor cost $1,194.19, making the total cost $2,459.67, or $2,714.67 including the easement. For labor we used the unemployed, and preferably those in arrears in water tax payments, these latter signing agreements that the amounts earned would be applied to reducing these bills. One foreman was hired, the city furnished a truck and the necessary tools and equipment and the writer was in charge as superintendent.

In 1936, plans were made for repaving Locust St. from First to Fourth with concrete, and the writer recommended in this connection that the storm sewer be extended up Locust St. with all necessary connections, manholes and catchbasins; this to be completed before the paving was done. This idea was adopted, and an application for WPA aid was granted, to include labor and $4,000 of materials; but after $993.60 had been received from WPA for materials the Federal policy was changed and no more materials were paid for. Work on the sewers started Jan. 18, 1937, and was completed on July 31. The city's share was paid for partly by the motor fuel tax funds which were allotted by the State.

The old 24" storm sewer was in such good condition that it was advisable to continue its use and construct the new one as a supplementary or relief sewer. The new sewer was connected to the old with 24" pipe at manholes at Park, Linden, Second and Third streets so that both functioned as a unit.

In designing the sewer, we based the run-off on that from a 10-year storm, using the values of "C" (coefficient of run-off) employed in Los Angeles, Calif. (See *Public Works* for June, 1934); also basing the rainfall rates on those determined for that city since there are no long-time rainfall records for De Kalb. The time of concentration and velocity (t and V) were de-



Laying sewer pipe in De Kalb.

TABLE 1

Description	*Unit & Cost*	*Total Cost*
36" Reinforced concrete pipe sewer	1008 lin. ft. @ 7.385	$7445.27
30" Reinforced concrete pipe sewer	1192 lin. ft. @ 6.202	7393.43
24" Vitrified clay pipe sewer	66 lin. ft. @ 3.634	239.86
21" Vitrified clay pipe sewer	389 lin. ft. @ 3.583	1393.94
12" Vitrified clay pipe sewer	102 lin. ft. @ 1.605	163.80
10" Vitrified clay pipe sewer (catch basin conn.)	279 lin. ft. @ 1.447	403.75
10" Reinforced concrete culvert pipe (catch basin conn.)	162 lin. ft. @ 2.021	327.43
Brick manholes complete	15 each @73.614	1104.21
Brick catch basins complete	27 each @77.313	2087.46
Manholes repaired	5 each @13.03	65.16
Curb and gutter, sidewalk and driveway reconstruction at locations where damages occurred		343.88
Total Cost		$20,968.19
Engineering		261.00
Total cost of project complete		$21,229.19

TABLE 2

Description	*Material—City*	*Material—Federal*	*Labor—City*	*Labor—Federal*	*Rental—City*	*Total Cost*
36" R. C. pipe sewer	$3746.20	.....	$ 213.90	$3207.32	$277.85	$7445.27
30" R. C. pipe sewer	2291.80	993.60	570.35	3134.47	403.21	7393.43
24" V. C. pipe sewer	99.16	.....	17.60	98.80	24.30	239.86
21" V. C. pipe sewer	461.44	.....	60.50	806.00	66.00	1393.94
12" V. C. pipe sewer	40.10	.....	22.00	94.70	7.00	163.80
10" V. C. pipe sewer (catch basin conn.)	76.75	.....	15.00	300.00	12.00	403.75
10" R. C. culvert pipe (catch basin conn.)	152.83	.....	7.40	153.70	13.50	327.43
Brick manholes	430.57	.....	202.70	411.94	59.00	1104.21
Brick catch basins	846.53	.....	473.90	671.03	96.00	2087.46
Manholes repaired	6.44	.....	13.65	45.07	.....	65.16
Curb & gutter, sidewalk and driveway reconstruction	89.79	.....	223.31	.....	30.78	343.88
Totals	$8241.61	$993.60	$1820.31	$8923.03	$989.64	$20,968.19

Cost to city	$11,051.56
Cost to Federal Government	9,916.63
Total cost	$20,968.19

termined from the formulas in Babbitt's "Sewerage and Sewage Treatment."

The computations are shown in the accompanying table. The total volume to be removed from each sub-area was calculated, from this was subtracted the computed capacity of the existing 24″ sewer, and the new sewer calculated for carrying the remainder. In designing the sewer below sub-area C, which was calculated at 33″ on a uniform .0124 slope, it was found that the sewer would interfere with water mains and sewer connections at Linden Place (about mid-length) unless it could be lowered. Accordingly a slope of .0142 was used down to Linden Place and .0107 from there to the other end of this section, and the size of the sewer changed to 30″ for the former half and 36″ for the latter.

Cost of Construction

Table 1 shows the cost of this work. The city furnished the necessary supervisory labor and equipment, which is tabulated in the following table. All digging was done by hand and excavation for the first three months was in 18 inches of frost.

Table 2 indicates costs of the various items shown in Table 1. Costs of material and labor are separate for both the Federal and city governments.

The estimated cost of construction of the items as shown in tables 1 and 2 was $17,183.75. This amount was based on the work being done on a contract basis. The net saving to the city is thus more than $6,000. The Federal Government's agreement to furnish materials in the amount of $4,000 would have increased the saving to approximately $9,000.

Testing Motor Vehicles for Mechanical Defects

Motor vehicle accidents caused 34 per cent of the 111,000 accidental deaths during 1936, and in the case of 15 per cent of these accidents vehicle defects were contributing causes, the National Safety Council estimates in its *Accident Facts, 1937*.

In an effort to eliminate this 15 per cent 18 states and nine cities now require examination of motor vehicles.

Each state or locality has its own standards to which vehicles in its jurisdiction must comply. In 1935, it was reported, only 28 per cent of the vehicles examined received a certificate of good condition. Fifty-eight per cent of those which failed to qualify needed lamp replacements or adjustments, according to the local inspecting agencies, 26 per cent were in need of brake adjustments or new brake linings, 11 per cent required adjustment or repairs to the steering mechanism, and 10 per cent had one or more minor defects. Records in one state showed that 55 per cent of the cars inspected had tires ranging in condition from only fair to poor.

Portland, Oregon, which started at the beginning of 1937 to test vehicles at a municipal testing station, is said to have found 2,408 trucks and cars out of 4,365 machines examined the first week unfit to be on the highways. New Jersey has also found a high percentage in unfit condition.

Requirements for inspections vary among the thirteen states and nine cities which now require examination for motor vehicles. New Mexico requires three inspections a year; Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, Pennsylvania, and Virginia require two inspections. Colorado requires one and permits two, and Delaware, Maryland, Utah, and Vermont require only one inspection a year.

A committee under the procedure of the American Standards Association and under the administrative leadership of the National Conservation Bureau of the American Association of Motor Vehicle Commissioners is now developing standards for inspection of motor vehicles, which may mean coordination of the various state and municipal requirements.—*Industrial Standardization.*

Minnesota Built 832 Miles of State Roads in 1937

With bids running exceptionally low, contractors completed construction work on 832 miles of roads for the Minnesota Highway department in 1937, built 49 bridges, installed 10 railroad crossing signals and laid down 113 monolithic culverts. This new construction cost $8,752,500.

These figures are for actual new building only and do not include maintenance improvements, costs of engineering, right-of-way purchases, supervision, plans and other functions necessary to construction programs. The largest single item of construction expenditures was $2,620,000 for 97 miles of new concrete pavement. While $569,000 was spent for 110 miles of bituminous surfaced highways.

Grading was the second greatest single item, with $2,425,000 being spent for 209 miles of such construction. During the year the department also contracted for $211,500 of shoulder grading and $26,000 of regrading. Sixty-six miles of stabilized aggregate surfacing, at a cost of $157,000, was laid down during the year; 102 miles of road were aggregate surfaced at a cost of $146,000; 19 miles of highway received an aggregate base at a cost of $17,000 and $310,000 was spent for 128 miles of stabilized aggregate base.

The Highway department, consistent with its policy of "building for safety" contracted for 12 railroad separation bridges costing $1,532,000, six highway separation bridges costing $320,000 and 29 stream separation bridges costing $530,000. The expenditure for 10 railroad crossing signals was $54,000. It cost $160,000 to build the 113 monolithic culverts.

Suggestions for Using Picks and Shovels Safely

The following suggestions for safe practices in excavation represent one man's recommendations:

Keep sufficient clearance both before and behind you. Inspect handles of picks and shovels. See that they are free of splinters and splits, that the point of the pick is sharp, and that the pick or shovel is securely fastened to the handle.

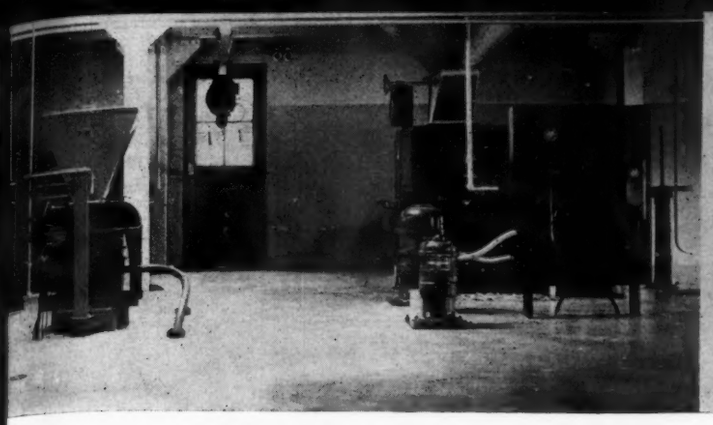
Use the ball of the foot, not the instep, to force the point of the shovel into the ground. Use the leg muscles as much as possible in shoveling.

Never throw or toss a shovel or pick toward another workman. Hand it to him with the handle forward. Never leave a shovel lying around where others may stumble over it.

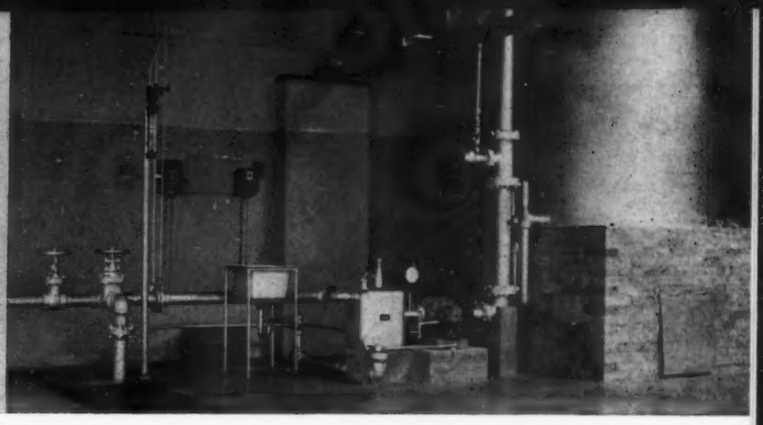
When not in use, stand it upright against something, or stick it upright in the ground.

Shore the ditch where the depth or soil conditions warrant it.

Never shovel material against the wind.—*National Safety Council.*



Lime and alum feeders



Recarbonation unit

Service Continued While Pumping Plant Is Moved and Softening Plant Installed

W. J. LAPWORTH

Plant Superintendent, Pittsburg, Kans., and T. D. SAMUEL, III, Resident Construction Engineer

PITTSBURG, Kans., population 19,000, in 1911 took over the privately owned waterworks system, consisting of two 8″ and 12″ wells 1,420 ft. deep with a capacity of 2,260 gpm; two duplex steam-driven pumps of 2 mgd capacity; a 600 cfm cross compound type Ingersol-Rand air compressor; three 150 hp horizontal return tubular boilers; an underground reservoir, a water tower and 36 miles of mains.

From 1911 to 1935 the municipality added a new boiler room, four 250 hp Scotch marine boilers to replace the old ones, a 4 mgd crank-and-flywheel pump, a 6 mgd steam-driven centrifugal pump, a 1,700 cfm cross compound air compressor supplying air to a new 12″ well 1,420 ft. deep and 19 miles of distribution mains. A steam heating service for the adjacent business district was established, underfeed stokers being installed for better operation in the boiler room. Use of the underground reservoir and water tower was abandoned and direct pumping established.

The plant in 1935 consisted of two 12″ and one 8″ wells, drilled approximately 1,420 feet deep and with a total capacity of 5,200 gallons per minute, pumped by air lift to two open reservoirs. Splash aeration was used to remove hydrogen sulphide but no other treatment was given the water. The hardness was 310 ppm, of which 270 ppm was carbonate. Iron and fluorine were not problems. The boiler plant consisted of four 250 hp Scotch marine boilers equipped with Jones underfeed stokers, steam operated. A single fan provided forced draft in a 116-foot brick chimney located in a corner of the pump room. Coal was received from trucks and unloaded by hand through windows of the structure into a coal bin in front of the boilers. Two small zeolite-type water softeners were in use for treating boiler water. In the adjacent pump room were three air compressors, a 4 mgd crank-and-flywheel steam engine and a 6 mgd turbine-driven centrifugal fire pump. A small machine shop and an old duplex pumping engine completed crowding the room. The floor and roof were of timbered construction.

The plant occupied a half city block in the business district and expansion of any of the facilities was impossible. The boiler and pumping plant and the department's offices were housed in frame buildings adjacent to a serious fire hazard. Elimination of the fire hazard and improved pumping facilities were needed and the citizens were demanding improved quality of water. Water Commissioner Clint B. Rankin convinced the City Commission that improvements were necessary, and Black & Veatch were employed to plan for them and to supervise construction. A PWA grant of $176,800 was obtained, the city issued $175,000 water revenue bonds and furnished $85,000 in cash.

W. J. Lapworth

Use of the deep well supply was continued. The steam pumping plant could not be moved far owing to the necessity of supplying waste steam to the nearby business area, and a site for a new boiler plant pumping station was purchased diagonally across from the old plant. A new fireproof structure was erected on the site of the old office building. When the new pump house was ready the old boilers, pumps and compressors were moved into it. Then a modern 3 mgd water softening plant was installed in the old pump house.

All of this was done without interrupting the water or steam service. With no elevated water storage and only 1,780,000 gal. ground storage this necessitated very close coordination of contractors and operating personnel. The work was done under eleven contracts, and at times four different types of work under different contractors were under way at once. The boiler plant had to be dismantled, moved about 750 feet and re-erected literally without letting the fires go out. The steam driven air compressors, fans and pumps had to be taken apart and set up on new foundations across the street. Mr. and Mrs. Pittsburg had to have water at their instant touch and fire protection had to be provided throughout the entire program. Due to such exacting procedure and inherent delays, the project required nearly two years to complete, although certain units were completed and in operation in about a year.

The first contracts let were for the new pump-boiler house structure, office building, concrete stack, new pump, crane, etc. The pump station is a fireproof structure comprising a 46 x 86 ft. boiler room and 42 x 120 ft. pump room (the two being separated by a tile partition), with a ceiling height of

The new office building and pumping station.

28′ 6″, containing a 10-ton crane. Floors and foundations are concrete; superstructure steel with brick and tile trim; roof of precast concrete slabs, supported on steel and covered with gravel-impregnated pitch. The interior contains a 7 ft. wainscote of colored glazed tile, above which is a lighter colored unglazed buff tile to which a tung oil glaze was applied. The superintendent's office is in one corner. A concrete basement with a ceiling height of 9′ 6″ provides easy access to all piping and equipment substructures, and contains the air filters, locker space, showers and toilets.

The pumps, including a new 4 mgd Allis-Chalmers crank-and-flywheel pump, as a standby, occupy the north half of the pump room, and in the south half are aligned the air compressors, of 600, 1,700 and 2,500 cfm capacity. All three compressors are supplied through a 16″ steel suction header and discharge into a 10″ header, from which individual valved lines, encased in vitrified tiles, go to the several wells.

The boiler room houses the four old boilers, two feed water pumps, feed water heater, zeolite softeners, stokers and control mechanism, dual fans and draft control equipment—all old equipment except draft control equipment and feed water pump. Coal is received direct from the mines by trucks which dump it into a receiving pit, where a reciprocating plate feeder fills elevating buckets which discharge onto a belt conveyor above the coal bunkers arranged in front of and above each boiler, chutes from which feed by gravity into the several stoker hoppers. Ashes are handled by a steam-operated vacuum system. Three ash hoppers are located in the floor in front of each boiler, from which the ashes are vacuum-pulled through an 8″ line to an elevated storage tank outside the building, permitting loading them by gravity into trucks. Water spray is used for dust control. Noise from free discharge of washed air from the ash receiver is eliminated by piping it into the stack. The ash handling system also removes soot from the rear boiler pass and ash accumulation from the stack base.

The reinforced concrete stack is 125 ft. high and varies in inside diameter from 11′ 8″ at the base to 6′ 6″ near the top, with an 8′ 2″ section at the tip.

A new 30″ cast iron water suction line was laid from the old reservoir to the new pump suctions. Normally the pumps are under positive head, which was physically impossible in the old layout.

Moving the plant to the new building was accomplished without accident or interruption of traffic. Reassembly and erection was under the direction of W. J. Lapworth.

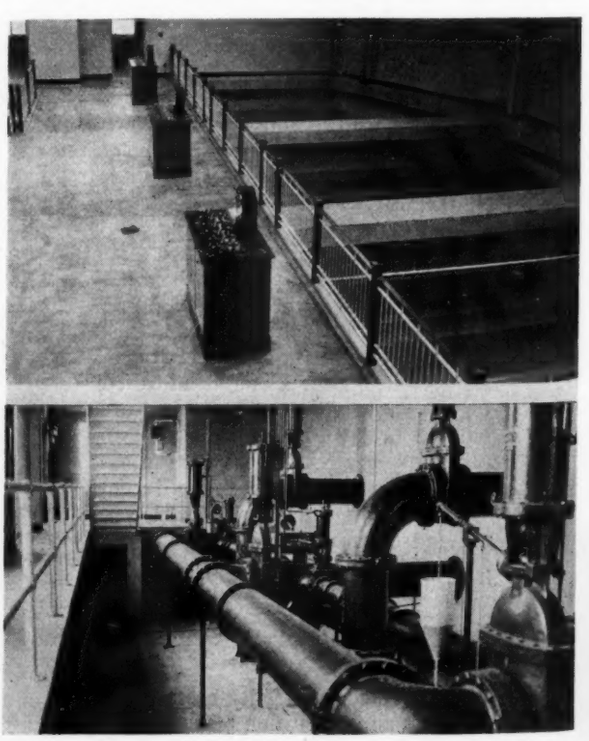
The new office building is of concrete and steel construction. The basement houses the meter testing and repair department. The accounting and office staff occupy the main floor, where a sound-proofed room is provided for calculating, bookkeeping and addressograph equipment, a large vault permits equipment to be wheeled in for storage and provides filing of records, etc. The office of the water commissioner also is on this floor, all of which is attractively finished in soft-toned plaster with a darker wainscoting of flexboard. The top floor is designed for storage and emergency purposes; at present it serves as office for the resident engineers of the Government and the consultant. A municipal public weighing station had been operated at the old plant and was continued at the new one, new weighing equipment being installed, and operated from the main office.

The Softening Plant

After the foregoing projects had been consummated, the construction of a water softening plant in the old pumping station was commenced. No explosives could be used in wrecking the old engine foundations and this "chat concrete" proved to be exceptionally hard and dense. Under-pinning the old building walls had to be resorted to for practically no footings were found under the old walls. The old brick chimney was demolished piecemeal and all usable construction salvaged.

The wells formerly discharged into a receiving structure located above ground so as to have gravity flow through aerators into the reservoirs. To eliminate these unsightly structures and exposed piping, it was decided to use Sullivan air-booster tanks located underground in concrete pits about the wells. The water is thus lifted several hundred feet in the well into the booster tanks, and the re-use of the air pressure lifts the water approximately 25 feet more to a common well discharge chamber. Here hydrogen sulfide is released and the entire treatment plant may be bypassed. From this receiving chamber the water flows by gravity through the plant to the reservoir and pumping station. The old boiler room houses the primary and secondary mixing basins and recarbonation basins. All basins are covered with concrete. The operating floor is 11.5′ above the old floor level, thus permitting excellent drainage, etc. Two lime feeder-slakers are above the tanks and the lime may be fed into either the primary or final mixing basin. Flocculator equipment is used in both primary and secondary mixing basins.

The old small circular mixing basin was relined,



Top—Filter room. Bottom—Pipe gallery.

SEEING'S BELIEVING

THIS unretouched photograph shows you how Goodyear truck tires wear—and wear and wear. These 13.50-20 Goodyear Pneumatic Lug tires have put in 14,657 miles on a 10-ton truck used in building the recently completed Cajalco Dam in Southern California — ***the roughest kind of off-the-road work.*** Yet note how little their powerful road-gripping treads have worn. Other tires on this project have averaged only 16,000 miles' total life —***but these Goodyears look good for at least twice that distance!*** That's why we say—put on Goodyears and watch your mileage jump.

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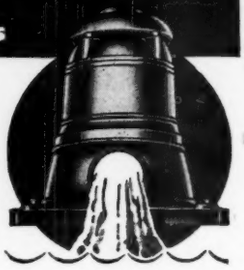

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(*"*"*The Old Oaken Bucket,*" by Samuel Woodworth)

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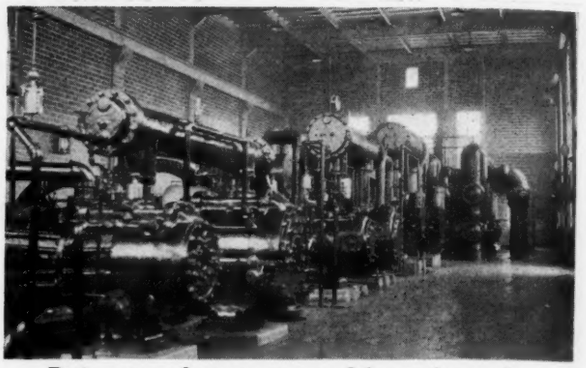


Engine room; 3 compressors and 3 pumping engines.

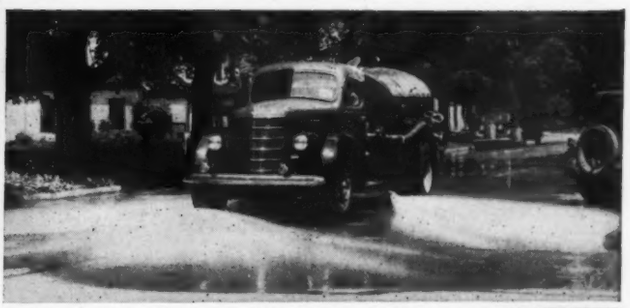
raised and equipped with a 71 ft. Dorr torq clarifier sludge-collecting mechanism to operate as a primary settling tank. From the final carbonation-settling tank, the water passes through three 1 mgd conventional designed rapid sand filters, and is stored in the old large reservoir, which has been relined and covered with a concrete slab. The filters are located in the old pump room and here also the operating floor is above the main floor level, thus eliminating any filter pipe gallery pit. An unusual feature is that water is admitted to the filters at the rear, thus curtailing the piping in the filter "gallery." For filter washing, a 40,000 gallon elevated steel wash-water tank has been located just outside the filter building. The building is entirely fireproof, the old wood roof having been replaced with concrete slab construction as used on the pumping station. New window sash and skylights were provided and ample ventilation installed. Natural gas is burned to provide carbon dioxide for recarbonation. A separate small brick structure is provided to house the lime elevating and distributing equipment, which is electrically controlled. To facilitate reaction, the return of sludge is possible.

Both treatment and pumping plants are extremely flexible and ample in size to serve the needs of the city for some years to come. Even should the well supply fail, the treatment plant can be immediately adapted to purification of a surface supply. Beautification of grounds about the plant will make it one of the most attractive places in downtown Pittsburg. The entire project was fostered and guided to a successful completion by Clint B. Rankin, Commissioner of Water.

The contracts for this improvement were as follows:

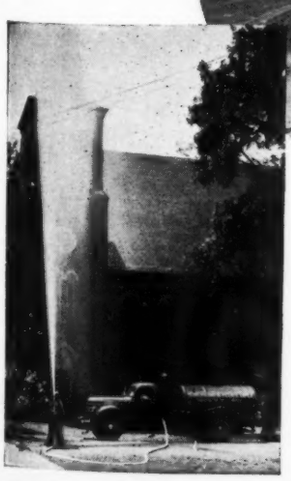
Project and Contractor	*Completion Cost*
New Pumping Plant Building—W. R. Grimshaw Company, Tulsa, Okla	$84,820.31
New Office Building and Scale Pit—W. R. Grimshaw Co., Tulsa, Okla.	27,339.53
125′ Concrete Stack—Rust Engineering Co., Pittsburgh, Pa.	5,890.00
10 Ton Crane—Shaw Box Crane and Hoist Co., Muskegon, Mich.	1,578.00
4 M.G.D. Steam Driven Crank & Fly Wheel Pump—Allis-Chalmers Mfg. Co., Milwaukee, Wis.	23,700.00
Section I. General Construction Water Softening Plant—W. R. Grimshaw Co., Tulsa, Okla.	137,166.50
Section II. "Filter Equipment" Water Softening Plant—E. W. Bacharach & Co., Kansas City, Mo.	22,475.00
Section III. "Steel Wash Water Tank & Tower" Water Softening Plant—Pittsburgh-Des Moines Steel Co., Des Moines, Ia.	4,249.00
Section IV. "Plant Sewer," Water Softening Plant,—Tri-State Const. Co., Pittsburg, Kans.	6,443.00
Sections I, III & IV. "Coal Handling Equipment—Moving Existing Equipment" and "Auxiliary Equipment, Piping, Wiring and Painting"—Power Service Corp., Minneapolis, Minn.	83,095.98
Section II. "Ash Handling Equipment"—Auxiliary Piping Contract—Vacuum Ash and Soot Conveyor Company, Newark, N. J.	7,738.84
Total Construction Cost	$404.496.16

South American City Uses This Fleet of New Internationals in Its Street and Fire Departments



Above: Front view of an International Truck—equipped with water tank and sprinkler—doing an efficient job of street washing. The picture at the upper right shows another view of the same equipment.

At Right: The progressive Municipality of Vincente Lopez, Argentine, South America, recently acquired this modern fleet of International Heavy-Duty Trucks equipped for use as street sprinklers and washers and fire trucks.



Above: This shows an International Truck with street sprinkling equipment in action.

At Left: A demonstration of the fire extinguisher equipment which shoots a stream of water about 100 feet high.

The fame and reputation of International Trucks go far and wide. Pictured here is a fleet of New International Heavy-Duty Trucks recently purchased by the Municipality of Vincente Lopez, Argentine, South America. The officials of this progressive city know the value of good equipment . . . that's why they chose Internationals when they were in the market for trucks.

When you examine and drive the New Internationals, you, too, will admire the many sound engineering improvements which are advancing the International reputation by providing peak performance at low operating cost. You get more for your truck dollar when you buy Internationals . . . the outstanding truck value on the market. Every type of work calling for trucks can be exactly suited by Internationals, available in sizes from the Half-Ton unit to the powerful Six-Wheelers. See our nearby Company-owned branch or dealer for complete details.

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INTERNATIONAL TRUCKS

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Details of Composite Timber-Concrete Bridge Design

W. A. STACEY

Engineer, Service Bureau, American Wood-Preservers' Association, Chicago, Ill.

A description of the composite timber-concrete type of bridge construction was given by Mr. Stacey in the December issue of PUBLIC WORKS. *In the following article he describes the method of computing the several dimensions for both simple and continuous spans.*

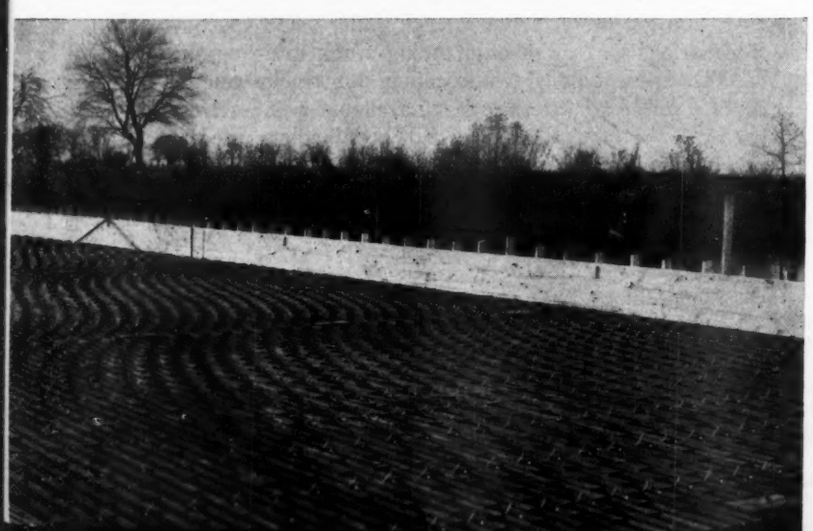
THE several principles of single beam design will be considered as follows:

PRINCIPLE I. *The timber portion of the beam carries all the dead load, and the composite beam carries only the live load.* Since the timber base assembly contains in itself all the strength required to sustain itself and the concrete load, no centering or supports are required between floor beams or piers. Therefore, as the concrete is placed, the timber base deflects to the elastic curve conforming to the elements involved, and the concrete assumes its form in a condition of no stress, and this applies also to the shear members. Hence in the stress calculations, dead load moments and shears must be segregated, and applied to the timber base only. Live load moments and shears are then applied to the finished *composite* section.

PRINCIPLE II. *The composite beam section is treated as a homogeneous timber beam and its elements determined accordingly, but its resisting moment is determined by applying the allowable working stresses in timber and concrete to the respective section moduli. The allowable working stress for the timber will be reduced by the amount of its dead load stress.* Obviously this principle is premised on the assumption that the modulus of elasticity of the concrete is the same as that of the timber. This, of course, is not strictly true, but for practical purposes in this particular type of design, it gives results which are on the conservative side and not materially different from those which would be obtained by transforming the sections.

*"Shear in Checked Beams," by J. A. Newlin, Forest Products Laboratory, U. S. Forest Service; page 1001, Proceedings of A.R.E.A., 1934.

Creosoted wood deck with shear developers and uplift spikes in place, ready to receive reinforcing steel and concrete. Mill Creek bridge at Smyrna, Delaware.



PRINCIPLE III. *Only live load shears are involved in the composite section.* In calculating shear, the load is placed at a point distant from the support equal to three times the depth of the (composite) beam. This is in accordance with the "double-beam" principle* which has been verified by tests showing that a part of the end reaction is not associated with horizontal shear.

The three principles given above govern general procedure in the design of the composite beam. Lateral distribution of concentrated load is assumed in accordance with the specifications of the American Association of State Highway Officials, using the formulae for distribution of concentrated loads on concrete slabs. This gives in general, for a single wheel, or either wheel of a single axle, a width not exceeding 7 ft., and for a single wheel of two or more passing axles, a width not exeeeding 4 ft. Most bridges are wide enough to accommodate two or more lanes of traffic, so the figure generally used is 4 ft.

Stresses in steel and concrete are increased 30 per cent for impact. Working stresses in timber already include provision for impact up to 100 per cent, so no increase should be made in these stresses. In other respects the loading diagrams and specifications of the A. A. S. H. O. are also used.

Computations for a Simple 20-ft. Span

In accordance with the preceding principles, computations are made as follows for a simple 20-ft. span on which a standard H-15 loading is placed.

The rear wheels of such trucks weigh 12,000 lbs. each. Assume for the composite beam, 2 x 8s surfaced to dimensions of 1.75" x 7.5", staggered vertically 1.75" and covered at the crown of the roadway with an average depth of 6 in. of concrete, as shown in Fig. 5. In these computations, stresses are considered for a width of 1 ft. of the beam.

Weight of wood per sq. ft. 7.5×5 lbs. $= 37.5$ lbs.
Weight of concrete per sq. ft. 0.5×149 lbs. $= 74.5$ lbs.

Total 112.0 lbs.

$$\text{Dead load moment} = \frac{112 \times 20^2 \times 12}{8} = 67{,}200 \text{ inch-lbs.}$$

Moment of inertia of wood section only:

$\frac{7.5^3}{12} \times 7.5 \times 0.88^2 =$	422
	69
	491

$$\text{Dead load bending stress in wood} = \frac{67{,}200 \times 4.62}{491} = 632 \text{ lbs.}$$

Live load moment on composite section: $\frac{1}{4} \times 3000 \times 20 \times 12 = 180{,}000$ inch-lbs.

Moment of inertia of composite section:

$\frac{12.62^3}{12} =$	2010
$\frac{1}{2} \times \frac{1.75^3}{12} =$	3
$12 \times 12.62 \times 0.44^2 =$	29
$6 \times 1.75 \times 6.75^2 =$	478
	2520

Compressive stress in concrete, including 30 per cent impact =

$$\frac{180{,}000 \times 6.78 \times 1.3}{2520} = 629 \text{ lbs.}$$

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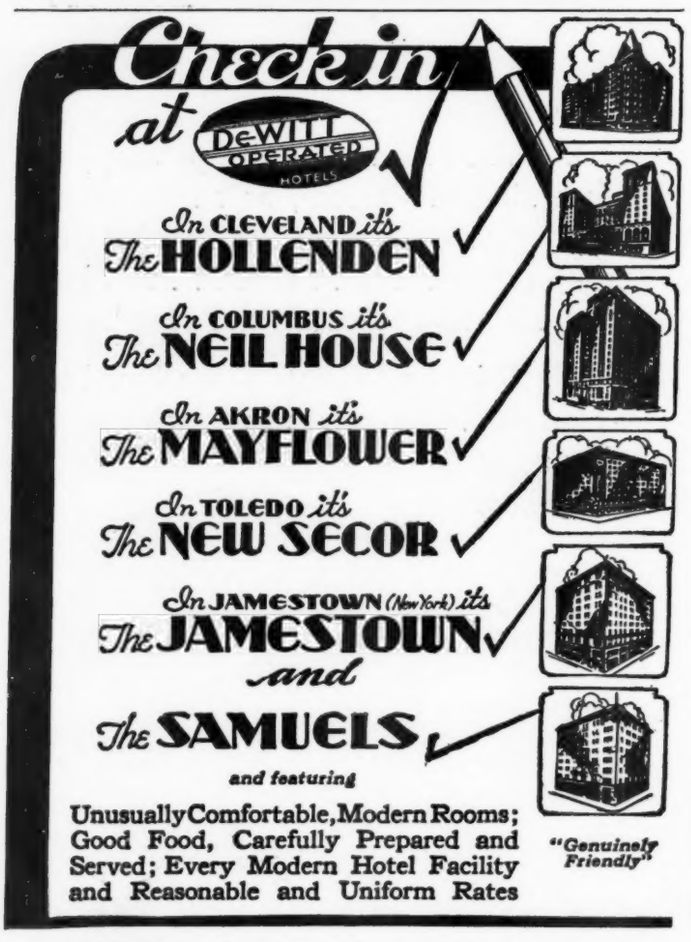

$$\text{Live load bending stress in wood} = \frac{180{,}000 \times 7.60}{2520} = 542 \text{ lbs.}$$

Total bending stresses in wood from both dead and live loads = 1171 lbs.

Computed spacing of live load Shear Developers:

Assume a lateral distribution of the 12,000-lb. wheel load over a width of 3 ft. near support and for maximum shear, in accordance with the two-beam principle, place wheel at a distance of 3d (3½ ft.) from point of support. Then the maximum shear on the neutral axis will be $\frac{1.5 \times 4000 \times 16.5}{20} = 4950$ lbs.

Area of beam cross section = 162 sq. in.

$\frac{4950 \text{ lbs.}}{162} = 30.6$ lbs. horizontal shear per sq. in.

30.6 lbs. x 144 sq. in. = 4400 lbs. shear per sq. ft. on neutral axis.

1750 lbs. = rated capacity of each Shear Developer.

$\frac{4400 \text{ lbs.}}{1750} = 2.5$ Shear Developers per sq. ft. at supports.

There are 3.43 grooves in timber deck per foot width of beam; hence $\frac{2.5}{3.43} = 0.73$ Shear Developers per foot in each groove.

$\frac{12''}{0.73} = 16''$ for the spacing of Shear Developers near supports.

This distance is ordinarily increased to 24" at mid-span. The Shear Developers are staggered in adjacent grooves.

The spikes used for assembling the timber strips should be long enough to pass through two strips and half way into the third (usually 30d spikes) and spaced in each lamination at about 30 in. There should be two gage lines for the spiking in each piece, spikes in the top line being inclined slightly downward and those in the bottom line slightly upward, to avoid undue approach to the edges of the timbers.

Shear Developer slots are cut across each groove at the design spacing by means of a chisel of the same size and shape as the Shear Developer itself. The chisel is contained in a steel or forged housing so constructed as to fit over the corrugated surface of the timber. Thereafter the Shear Developer is placed in the slot and made secure by the blow of a small sledge. On average work, three men will cut the slots for, and place, about 2,000 of these members per working day. The work of placing reinforcement and concreting the deck then follows in the usual manner.

In a simple span construction, the reinforcement required in the concrete is only that to provide for shrinkage and temperature stresses, ordinarily not more than ½-in. round bars at 9-in. centers each way.

Where it is desired to employ continuous span construction throughout the panels of a truss or girder bridge, or multiple span trestle, this may be done by breaking the joints in the timber strips. In this, as in simple span construction, all timber strips should be of full panel or span length, and the joints broken in such manner that suitable beam action may be secured at any point. A common arrangement, and probably the best, is to stagger the pieces so that each third strip will run from support to support, and the remaining two of the group from the two quarter points of one span to the corresponding quarter points of the adjacent span. This order is then repeated throughout the roadway width.

Calculations for continuous beams are similar to those for simple spans, except that the beam elements must be calculated on the basis of *net*, and not gross section, and simple span moments will be distributed between mid-span (positive) and supports (negative).

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For the positive section, where timber strips are spliced in the 3-group system as pointed out above, 2 out of 3 strips will be effective, and the beam will be calculated as for the full flange width of concrete—i.e., 12 in., with 8 in. width of timber. The neutral axis and moment of inertia of the section will then be determined.

For the wood section alone, the moment of inertia will be constant throughout (on the basis of 8 in. width of timber per 12 in. width of slab), but for the composite section over the supports the beam will consist of timber and negative steel only, and its elements will be calculated by transforming the steel to equivalent timber on a basis of $n = \frac{E_s}{E_w}$ equal to 20 ±.

The dead load moment will be divided by 2 and applied to the timber section for stresses at mid-span and support. Fifty per cent of the live load moment will be applied to the negative composite section, and the negative stress as determined from the transformed section (upper side) will be multiplied by 20 to give the actual steel stress. Sixty-seven per cent of the live load moment will be applied to the positive (mid-span) composite section and the stresses determined as above.

The section computed above for 20 ft. single span will obviously be sufficient for the same span continuous under the same loading (H-15) and stresses in both timber and concrete will be somewhat reduced, notwithstanding the reduced width of the tension side of the beam. For 20-ft. spans, the steel over supports will be ⅝-in. round bars 8 ft. 0 in. long, spaced at 9 in. Alternate bars will extend 5 ft. 0 in. and 3 ft. 0 in. on one side of the supports, respectively, with the reverse dimensions extending on the other side.

Because of the reduced section in continuous spans, the spacing of Shear Developers will be shortened to about 13 in., common practice being to make this 12 in. and increase the spacing gradually to 24 in. (some prefer 18 in. maximum) at mid-span.

Continuous span construction, if well done, has advantages in addition to the reduction of stresses in the concrete and timber. The stiffness of the structure is greatly increased, and a superior roadway surface is obtained. In any case, however, continuity should not extend over 150 to 200 ft., at which points the deck should be completely cut, for an expansion joint. One of the very important factors to take into account, in continuous construction, is whether or not unyielding supports can be provided for the structure. If there is any likelihood of the supports settling, continuous construction should be avoided.

Obviously, some provision for a proper sequence of concreting must be made in continuous span construction; otherwise transverse cracks are apt to occur in the slab as a result of the load of green concrete in one span causing tension in the partly set concrete of an adjacent span. This may be avoided in various ways, but the simplest method, probably, is to follow a procedure of concreting in which the work will commence (1) at one end span and proceed to the remote quarter point of that span; (2) concrete is then deposited in the next span, filling in the mid-span portion between quarter points; (3) the next step is to fill in the gap between steps (1) and (2), and this process is continued until the work is completed. By following this

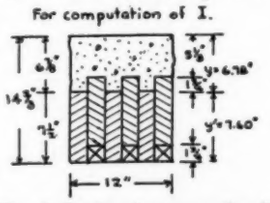
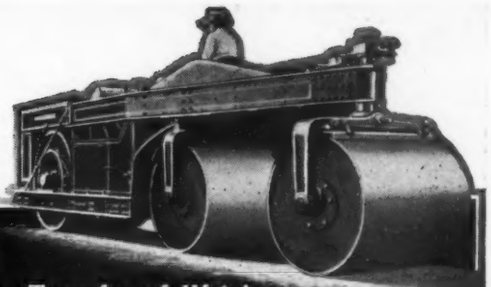


Fig. 5. Section for computing I.



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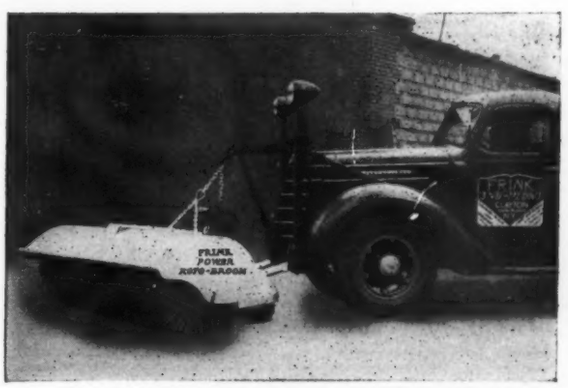

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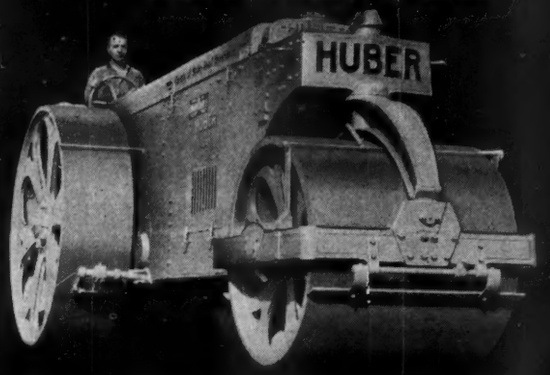

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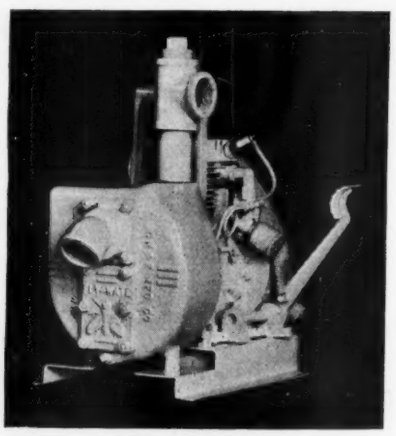

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sequence, all the tension in the timber sub-deck is developed *before* concrete is placed in the negative areas, and none, therefore, is transmitted to the partially set concrete. If required, construction joints may be located either longitudinally or transversely at the conclusion of any of the steps described above.

In concreting the deck of simple or continuous multiple spans, a further precaution is to be taken in connection with the curbs (if of concrete). Where curbs are poured *with* the slab in a continuous operation, no structural difficulty will be encountered other than the inconvenience of screeding and the extra pains of securing good lines. Where the slab is poured first, and the curbs in a following operation, a facia beam of concrete, or extra depth of timber base should be provided to carry the curb load without causing additional deflection, as this is likely to cause a longitudinal crack in the slab. The facia beam of concrete, if used, should be properly reinforced and supported until completely set (7 day min.) If the supports are independent of the structure itself, the curbs may be poured at any time. If these supports depend on the slab itself, the pouring of the curbs should be delayed until the facia beams are capable of carrying the load.

One of the advantages of the facia beams is the protection afforded the timber deck along its sides, and another is the architectural effect that may be obtained from the apparent deep girder-like construction. Such beams are thoroughly bonded to the timber by means of protruding wood screws, usually ½ in. x 10 in., set at about 36-in. intervals in the face of the timber.

Since all concrete in a composite structure is, in the final analysis, supported by the timber laminations, no part of it must be allowed to rest on other parts of the structure, such as the caps, floor-beams, bracing or back walls. This is because any eventual shrinkage in the timber will prevent uniform bearing at such points and thus may result in undue strain in the concrete. Where, as in facia beams, it is convenient to allow them to rest on the floor-beams or caps, at least ¾-in. thickness of bituminous felt should be placed for a bearing.

It will be seen that the laminated composite type of bridge deck possesses the advantages of the stringer or beam-stem type, enumerated above, together with additional advantages which contribute to economy, convenience and the structural behavior of the construction. The relatively small sizes of timbers required are usually more readily obtained, and are likewise cheaper per unit of volume, than stringer size timbers. Their preservative treatment is more effectively and easily accomplished, adding to the durability of the construction. Since the timber base is continuous over the width of the slab, no forms or form-work are required for the concrete, except as may be required for curbs and handrails at the option of the designer. The sub-deck prior to concreting may be utilized for traffic of any form, including the convenience of maintaining regular traffic on one half of the roadway while the other half is being concreted and cured.

The wide distribution of concentrated loads, as established by loading tests, virtually eliminates shear on vertical planes between and parallel to the timber laminations, thus avoiding deck distortion and thereby contributing to the structural integrity of the construction. The vibration and impact of moving loads is thoroughly cushioned by and absorbed through the multiplicity of the timber members.

Assistance in preparation of this paper is gratefully acknowledged to J. F. Seiler, who originated the Shear Developer type of design.

Significant Announcement

I CONSIDER this one of the most important and significant announcements that Barber-Greene has ever had the privilege of making, as it may lead to new trends in bituminous road construction.

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H. H. Barber

President Barber Greene Company.

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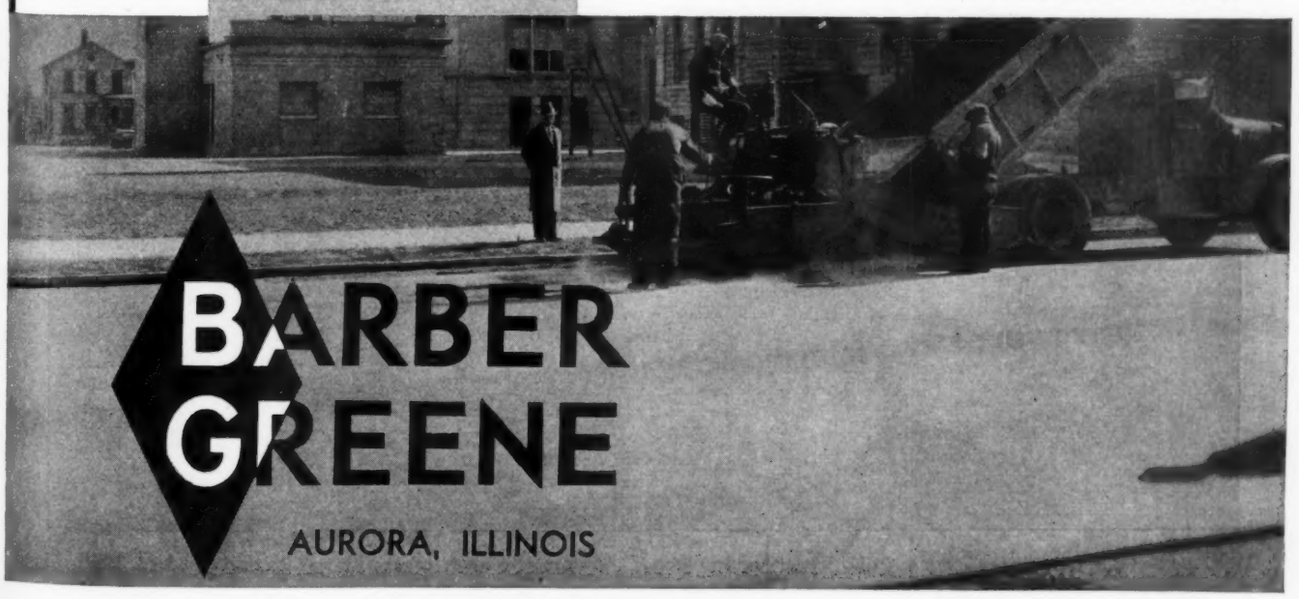
38-5



BARBER GREENE

AURORA, ILLINOIS

Building Mosquitoes Out

By NELSON H. RECTOR

Assoc. M. Am. Soc. C. E., Assistant State Director of Malaria Control, Miss. Board of Health

THE first permanently lined ditch in the State of Mississippi was completed in May, 1936, and since that time, approximately 20 miles of invert have been constructed in 62 Mississippi towns. The term "invert" is understood to mean the bottom lining of an open ditch with durable material. This program has met with favor from the general public and from engineers and officials of local, State, and Federal governmental agencies. The principal benefits resulting from this work are: first, the elimination of mosquito breeding areas; second, the reduction in the cost of mosquito control by oil or larvicides; third, the protection of culverts and bridge structures; and fourth, the conservation and beautification of both public and private property.

These inverts, in addition to building mosquitoes out, have transformed unsightly swamps, bayous and sloughs, enhancing the value of adjacent property and beautifying the town. In several instances, property owners have converted the ditch banks bordering the concrete inverts into flower gardens.

Since the initial invert construction, efforts have been largely directed toward the study of practical, economical means for lining ditches and for protecting banks in order to reduce maintenance costs. Experiments have been conducted to determine the minimum amount of material required to construct a satisfactory invert on different grades and on varying subgrades. Our experience shows that a round bottom invert, with the ditch banks covered with Bermuda sod, is the most practical type for conditions in Mississippi. The template used in constructing an invert is always an arc of a circle. Fig. 1 and Table 1 illustrate the shape of the invert and give the actual measurements and quantities.

Concrete inverts are poured as monolithic slabs 3″ thick, and are reinforced with wire mesh if the subgrade is not satisfactory. The mixture used is 1-3-6. Brick inverts are constructed of bricks set in 1-3 mortar.

After the ditch is roughed out to approximate grade, forms are set to correct line and grade, stakes set on the center line at 6-ft. intervals to the finished grade of the invert, and the subgrade carefully shaped by means of the template shown in Fig. 2. The radius for this template for any given sized ditch is secured by adding 3″ to that shown in Table No. 1.

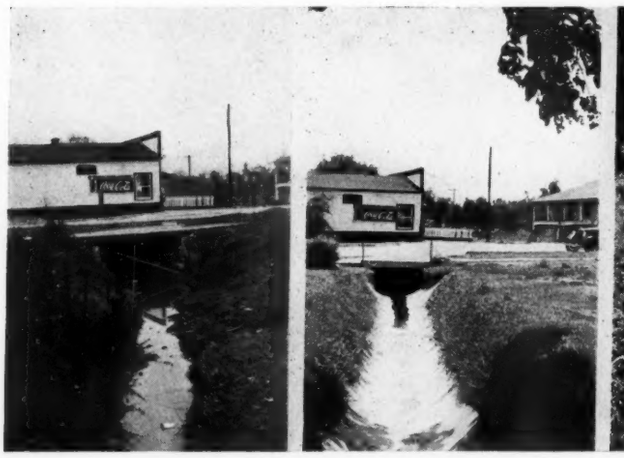
If the subgrade is soft, it must be compacted with heavy metal tamps. Occasionally, it is necessary to construct diversion ditches parallel to the side of the invert to lower the water on the center line in order to secure a satisfactory subgrade.

The concrete, mixed either by hand or by mixer, is placed between the forms and is worked into shape by a heavy template, Fig. 3. The invert is finished with the hand tools usually used in laying and finishing concrete. The correct grade is obtained by checking the center of the invert with a straight 2″ x 4″, 6½′ long, resting on the grade stakes which are 6 feet apart.

Expansion joints made of asphalt or tar are provided at intervals of 80 to 100 feet, and cross or curtain walls 6″ to 1′ deep are constructed under the invert to prevent underflow. Weep holes are made in the invert immediately above the curtain wall. On steep grades, the depth of the curtain walls per station should exceed the grade of the ditch to prevent any flow under the curtain walls. Both brick and concrete inverts are cured under water or damp soil for six or seven days. Brick to be used in an invert is soaked in water for at least twelve hours preparatory to setting in mortar.

Experimental asphalt inverts have been constructed, and one section is still in good condition after sixteen months of service. However, enough time has not elapsed to make any positive statements as to the usefulness of this material for ditch lining.

Preparatory to laying the asphalt, the ditch was cut to grade and lined with large native rock shaped to conform roughly to the shape of the template. The rock was sprayed with a paint coat of liquid asphalt (RC-1). The dry mixture consisted of 70 per cent rock asphalt and 30 per cent sand; 9 quarts of RC-1 and 3 quarts of low grade gasoline were added to each 4 cubic ft. batch of the dry mixture. These were mixed thoroughly



Before and after; concrete invert drain, Water Valley, Miss.

Before and after; concrete invert drain, Woodland, Miss.

Vicksburg, Miss.: brick and mortar invert drain, before and after

Drain with riprapped sides, Columbus, Miss.

in a concrete mixer and raked over the rock and into the voids so as to form a lining 2" thick before compacting. The loose asphalt was compacted with a tennis court roller and then sprayed with another paint coat of RC-1.

Our experience shows that sod grows very rapidly, taking hold even in poor soil, and is effective in preventing erosion on ditch banks, thus reducing the future maintenance cost of the drainage system. A blanket Bermuda sod controls erosion even on steep grades and makes it possible to reduce the size of the inverts.

Experiments have been conducted to determine practical means for forcing the growth of sod, and it has been found that wood ash is a satisfactory fertilizer. Last year, sod treated with wood ash grew and stayed green all winter; whereas, non-treated sod did not continue growth. It may be possible to reduce further the size of inverts and to use less riprap above inverts on the outside of curves by stimulating the growth of sod at all seasons of the year.

Naturally the water-carrying capacity of culverts and bridge openings is materially increased when concrete or brick inverts are constructed, due to the removal of obstructions and the reduction in friction, resulting in an increased velocity. Where round bottom inverts must join wide, flat bottom culverts or bridges, steps are taken to reduce the width through the structure in order to increase the velocity sufficiently to prevent the deposit of silt.

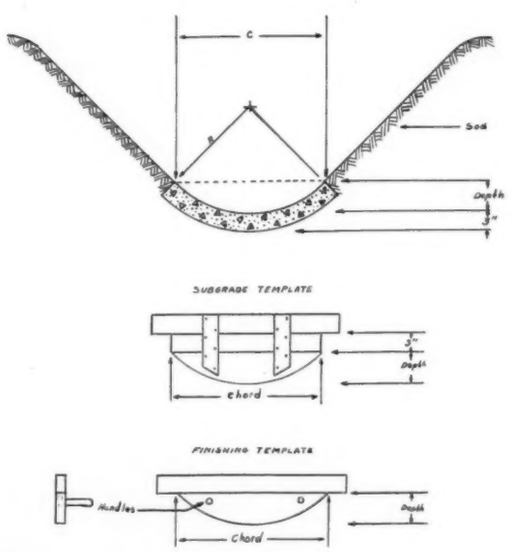


Table No. 1.

DESCRIPTION						100' CONCRETE INVERT			100' BRICK BOTTOM		
Chord "C"	Radius "R"	Depth "D"	Length of Arc	Sq.Ft.in End.Sec.	Cu.Yds.in 100' Sec.	Sacks Cement	Cu.Yds. Sand	Cu.Yds. Gravel	Sacks Cement	Cu.Yds. Sand	Number Brick
1'	.70'	.20'	1.09'	.32	1.20	4.84	.55	1.10	4.41	.46	457
2'	1.41'	.41'	2.20'	.60	2.20	8.96	1.02	2.04	8.09	.85	924
3'	2.12'	.62'	3.30'	.88	3.24	13.08	1.49	2.98	11.86	1.25	1386
4'	2.83'	.83'	4.48'	1.17	4.30	17.37	1.97	3.95	15.82	1.66	1881
5'	4.50'	.76'	5.30'	1.36	5.03	20.32	2.31	4.62	18.49	1.94	2226
6'	5.40'	.92'	6.36'	1.66	6.04	24.40	2.77	5.55	22.17	2.33	2671

Fig. 1—Invert templates and quantities of materials

Under conditions in Mississippi, the average cost per square yard for concrete inverts 3" thick is $1.24, of which 64 cents is for materials and 60 cents for labor. Brick inverts are laid at an average cost of 77 cents per square yard, of which 41 cents is for materials and 36 cents for labor. The brick for these inverts was donated. The average cost per square yard of sod in place and fastened down is 32 cents. This cost includes hauling the sod approximately 600 feet. The average wage received by a W. P. A. laborer in Mississippi is 25 cents per hour.

If the leading citizens are sufficiently interested in malaria control to demand action, this type of work can be undertaken in practically any town or city. For example, in one small village having a very limited revenue, the officials stated that no money could be appropriated for malaria control. A friend of this Division in the town donated ten dollars for the construction of a 2-ft. bottom invert 100' long adjacent to a public square. The demonstration, as originally planned, stimulated interest, and the village, without further request, appropriated one hundred and fifty dollars for the construction of concrete inverts.

Filling is also used as, where applicable, it is an ideal method of mosquito control, meeting with the general approval of the public. Unsightly areas that are difficult to drain can be transformed into parks; and by filling future control work is eliminated.

In years gone by, Madam Anopheles has taken a tremendous toll in Mississippi first, in lives lost; second, in the time lost during illness; and third, in lowered vitality and efficiency. This toll can be checked and eventually stopped by building mosquitoes out through hard, consistent work applied over a period of years.

Protecting Pipe Laying Workers From Injury

In an action by a pipe-laying helper injured while working at the bottom of a ditch from 6 to 9 feet deep which was being dug for sewer pipes, the principal question was as to the master's duty to pile the excavated earth far enough away from the edge of the ditch to prevent earth and rock from falling into the ditch. Plaintiff was injured by a falling rock. The Arkansas Supreme Court held (McEachim v. Martin, 102 S. W. [2d] 864) that while a witness might be asked if the experience of construction contractors in similar work had crystalized into rules regulating the manner of doing such work, and as to what those rules were, it was reversible error to admit in evidence a manual of accident prevention of a contractors' association, although the city's contract provided that all hazards should be guarded in accordance with the manual.

A Digest of the Sewerage Literature of the Month giving the main features of all the important articles published

The Digestion Tank

Garbage and sewage sludge, mixed in the proportions actually produced at Flint, Mich., produced 11.5 cu. ft. of gas per lb. of volatile matter, which constituted 83% of the mixture—91% of the garbage and 75% of the raw sludge. When lime sludge (from water softening plant) was added in the proportion of 1.16 parts to 1 part of combined sewage and garbage solids, the mixture digested readily with no appreciable decrease in gas production. When 2 parts of lime sludge was added, the mixture still digested readily but produced slightly less gas and with a lower CO_2 content.[C38]

Flow of sludge is pseudo-plastic and thixotropic. Studies indicate that (1) quiescent thick sludges will have viscosities of 3,000 to 5,000 centipoises at very low rates of flow, (2) as the velocities increase the viscosities will decrease to 200 to 300 centipoises, (3) at turbulent flow the viscosities may drop below 100 centipoises and (4) from these viscosity ranges the loss of head or pressure drop may be approximately calculated. A formula and table are given in the article.[C41]

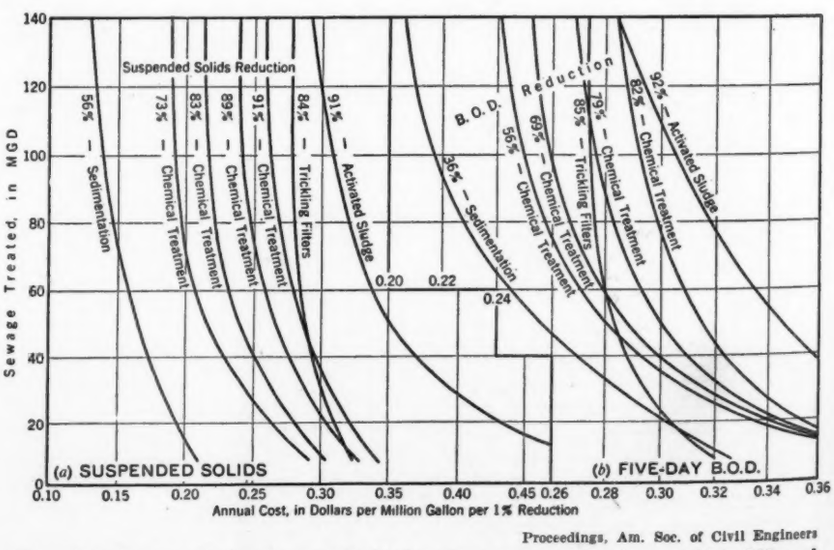
The **gas engine** generating plant at Coney Island, using monthly averages of sludge gas between 83,299 cu. ft. and 125,961 cu. ft., during 15 mos. operation developed all the power necessary to pump sewage, operate the plant and supply practically all heat needed for digestion and buildings, with no power failure or major repairs or replacements and practically no cylinder or bearing wear. Under full load the engines developed a brake hp. hr. for every 9,500 Btu, generating one kwh per 25.9 cu. ft. of gas, equivalent to 17.3 cu. ft. per bhp hr., allowing for efficiency of generator.[C44]

Sludge collector maintenance needs attention at regular but comparatively long intervals. Speed reduces and motors should be lubricated strictly according to manufacturers' directions. Babbitted bearings should be greased once a week. Open gears and chains should be lubricated once a week with heavy grease applied with a paddle. When a tank is not operating it should be kept full of clean water and the collector operated every two or three days. Wooden flights should be kept immersed, or else removed and stored under cover.[J14]

Sewer spans of 105 ft., self-supporting, have been built across the Platte river at the Denver sewage treatment plant — the longest spans in the world. The pipe is 78" inside diameter, made of corrosion-resisting metal from 5/8 to 1 1/8 in. thickness. Stiffener rings hold the pipe to its circular shape. Calculated for a combined vertical dead and live load of 5,000 lb. per lineal ft., including the sewage therein. Cost was 20% less than a steel truss carrying a concrete or steel pipe, or a steel pipe supported by a number of piers.[E11]

Economics of sewage treatment involves not only costs, but results obtained, and these in turn are generally determined by the degree of treatment necessary for the plant in question. Mr. Schroepfer has attacked the problem in a general manner, but calls attention to the importance of considering the effect of influencing factors upon conclusions relative to a definite project, which effect dictates that almost every project be analyzed separately; stating that "the fundamental and controlling economic factor is the degree of treatment necessary. . . . Sufficient and well proved processes are available to satisfy, economically, the requirements of almost any problem that may arise." In comparing the various processes which are in common use, he gives the cost of each per 1% reduction in suspended solids and in B.O.D. per million gallons treated, for plants of 10 million to 100 million gallons capacity, based upon actual figures for a large number of plants, for both construction and operation. For example, for a 20 mgd plant, treating sewage with 185 ppm of suspended solids and 200 ppm of 5-day B.O.D., the cost per unit of 36% B.O.D. reduction by sedimentation would be the same as for 85% by trickling filters—about 30 cts. The unit cost of 56% reduction by chemical treatment would be 33 cts., 82% by chemical treatment, 35 cts.; and 91% by activated sludge, 43 cts.

The effect of degree of treatment on cost is illustrated by sedimentation for detention periods of 0.5 to 4.0 hrs.; the costs ranging, per B.O.D. unit, from 38 cts. at 0.5 hr. to 21.3 cts. at 3 hr., then increasing to 21.7 at 4 hr. This lowest unit cost—21.3 cts.—is equaled by an activated sludge plant with 4 hrs. aeration, and



Proceedings, Am. Soc. of Civil Engineers

Annual costs per unit of various methods of sewage treatment in plants of 10 to 140 mgd.

Installation of 10-inch U. S. Super-de Lavaud Pipe for pressure sewerage line at Kingsville, Texas.

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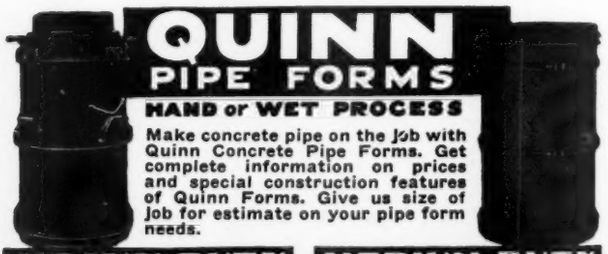

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The article contains a mass of similar figures for all kinds of plants, with suggestions for using them effectively.[K9]

Atmospheric reaeration of water is shown by studies of the U. S. P. H. Service to be retarded by the admixture of sewage or sewage sludge under stream flow conditions and especially at high velocities, even when the amount of sewage is only a few per cent. With mixtures up to 25%, the maximum effect, observed at velocities above 10 to 15 ft. per min., decreased rapidly below 10 ft. per min., and below 5 ft. little significant difference was observed between the sewage and tap water reaeration rates, though a slight retardation was indicated.[C36]

A test of the solubility of atmospheric oxygen in domestic sewage, from air applied as a fine spray of bubbles from "Aloxite" diffusion plates, indicated that it was approximately 95% of its solubility in distilled water.[C37]

Chlorine handling at a maximum rate of 3,920 lbs. daily was performed at the Jamaica sewage treatment station of New York City in 1937. Chlorine in 1-ton cylinders is removed from trucks by a monorail and 3-ton chain hoist to cradles, 22 for storage and 8 in an operating pit, which, in case of severe leak, can be flooded with caustic solution from a tank on the outside of the building which holds 540 gal. of 50% solution. The pit can also be flooded with water; and an exhaust fan is provided to draw cold air (or leaking gas) from around the cylinders. Each operating cylinder feeds through flexible copper tubing to two headers that run underground to the feeding room. Here 5 vacuum-type chlorinators (one 200-2,000 lb. adjustable, one 100-300 lb., and three 750 lb. fixed) feed into a header of rubber-lined wrought iron pipe, and from this by two 3" hose to the pump well. By means of pressure-reducing valves, gas is delivered to the chlorinators at relatively uniform pressure; chlorine is held back in 4 full cylinders to allow the other 4 to empty; no re-liquefaction can take place in the line which might otherwise be caused by low temperature; there is a substantial saving of chlorine as the cylinders are all exhausted.

Residual was maintained of 0.2 to 0.5 ppm for three weeks, then 0.5 to 1.0 ppm, on a flow of 25.6 to 39.2 mgd of screened effluent; dosages varying between 62 and 142 lb. per mg, and between 1,700 and 4,550 lb. per 24 hr.[C45]

The largest sewage chlorination plant is the Cleveland Easterly—capacity 12,600 lb. per day, and new equipment of 28,000 lb. capacity is to be installed this year. A plant of 30,000 lb. capacity is to be installed next year at the Minneapolis-St. Paul plant. Solution feed requires about 30 gal. of water per lb. of chlorine; sewage effluent for this purpose involves some waste of chlorine. Large plants call for additional safeguards, accuracy and reliability.[C46]

Pumping station and force main maintenance in Rochester, N. Y., includes visiting each station once or twice daily, and cleaning screens, checking lubrication of pumps and motors, adjusting sequence of operation of units, and determining any abnormal conditions. Lubrication is the most important. Shaft wearing sleeves of either alloy bronze or Monel metal and a reasonably soft and graphite-impregnated packing give best results at Rochester. Insulation of motors should be tested periodically to prevent burn-outs. A great source of annoyance and expense is failure of electrical controlling apparatus to function, because of insufficient ca-

pacity, and of materials in the contacts. For the latter, "Elkonite" seems best facing for the hard-drawn copper contacts. For keeping force mains clean, at long intervals all pumps are operated at once to flush a main, the additional water necessary being obtained by use of fire streams.[C50]

Bibliography of Recent Sewerage Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

Sewage Works Journal
March

34. *t.* Hydrolysis of Starch by Activated Sludge. By H. Heukelekian and R. S. Ingols. Pp. 209-218.
35. *t.* Hydrolysis and Bacterial Utilization of Complex Nitrogenous Materials by Activated Sludge. By H. Heukelekian and R. S. Ingols. Pp. 219-227.
36. *t.* Effect of Sewage on Atmospheric Reaeration Rates Under Stream Flow Conditions. By R. W. Kehr. Pp. 228-240.
37. *t.* Solubility of Atmospheric Oxygen in Sewage. By W. A. Moore. Pp. 241-246.
38. Digestion Experiments at Flint, Mich., on Sewage Sludge, Garbage and Lime Sludge Mixtures. By P. R. Welch. Pp. 247-260.
39. *t.* A Modified Eijkman Medium for the Isolation of Escherichia Coli from Sewage. By A. A. Hajna and C. A. Perry. Pp. 261-263.
40. *t.* Biochemical Oxygen Demand Test and Oxidation in Sewage Treatment. By C. C. Ruchhoft. Pp. 264-271.
41. *t.* The Pseudo-Plastic Properties of Sewage Sludges. By W. D. Hatfield. Pp. 272-275.
42. Experimental Work in Progress at the West Side Sewage Treatment Works of the Sanitary District of Chicago. By T. L. Herrick. Pp. 276-292.
43. Better Sewage Works. By G. B. Gascoigne. Pp. 293-300.
44. Utilization of Sludge Digestion Gases at the Coney Island Sewage Treatment Works. By W. Donaldson and H. Liebman. Pp. 301-310.
45. Handling and Feeding Chlorine at the Jamaica, N. Y., Screening Plant. By G. E. Henkel. Pp. 311-318.
46. Aspects of Sewage Chlorination. Discussion of C22. Pp. 319-321.
47. Treatment of Sulfur Dye Wastes by the Activated Sludge Process. By H. J. Miles and R. Porges. Pp. 322-335.
48. Qualifications Prescribed for Sewage Treatment Plant Operators in New York State. By A. F. Dappert. Pp. 336-340.
49. Operators' Gadgets. Pp. 340-343.
50. Maintenance of Pumping Stations and Force Mains. By J. V. Lewis. Pp. 343-346.

D *The Surveyor*
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30. *p.* Mechanism of a Refuse Handling Depot. By C. N. Cowney. Pp. 417-419.

April 1

31. Rural Sewerage and Sewage Disposal. P. 475.

April 8

32. *p.* Some Problems Peculiar to Trade Waste Treatment on Factory Estates. By M. A. Kershaw. Pp. 511-513.

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33. Sewage Pumping Plant at Abbey Mills. Pp. 543-544.
34. *p.* Small Sewage Disposal Works. By F. C. Temple, Pp. 557-560.

E *Engineering News-Record*
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10. *p.* Practical Pointers on Centrifugal Pumps. By M. M. Klosson. Pp. 513-514.
11. Longest Self-Supporting Pipe Built at Denver. By B. G. Norfolk. P. 552.

G *Water Works & Sewerage*
April

18. Sewerage Facilities Hard Hit by Southern California Flood. By A. M. Rawn. Pp. 248-251.
19. Sewer Maintenance. By J. H. Brooks, Jr. Pp. 261-267.
20. Activated Sludge Plant Operation. By W. H. Wisely. Pp. 271-276.

H *Municipal Sanitation*
April

37. *p.* Pumps for Sewage Work. By A. Peterson. Pp. 214-216.
38. *p.* Sewage and Sludge Pump Characteristics. By S. E. Kappe. Pp. 217-220.
39. Incineration of Municipal Refuse. By H. W. Taylor. Pp. 221-223.

J *American City*
April

14. The Maintenance of Sludge Collectors. By H. F. Watson. Pp. 65-66.
15. Sewage Treatment at Hot Springs, Ark. By T. R. Kendall. Pp. 76-78.
16. *p.* Incinerators for Garbage and Refuse Disposal. By A. E. Stilson. Pp. 109-117.

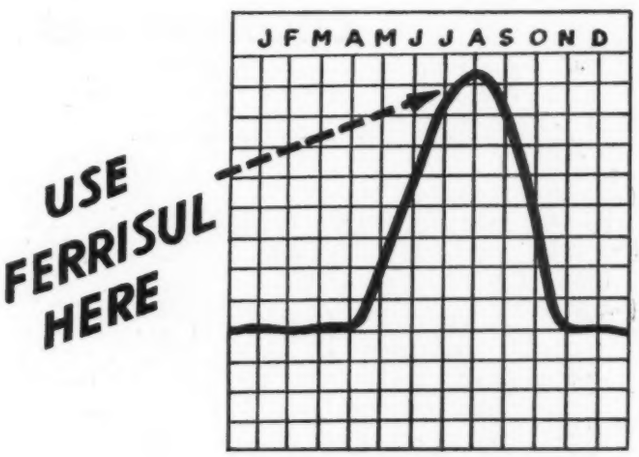
K *Proceedings, Am. Soc. of Civil Engineers*
April

9. Economics of Sewage Treatment. By G. J. Schroepfer. Pp. 737-765.
10. *t.* Deoxygenation and Reoxygenation. By C. J. Velz. Pp. 767-779.

P *Public Works*
April

15. Sludge Gas Utilization at Wichita, Kans. By P. L. Brockway. Pp. 14-16.
16. Know Your Subsoil Conditions Before Trenching. P. 52.
17. Sanitation Beyond the Sewer Lines: Disposal of Effluent. Pp. 70-71.

For Summer Sewage Problems



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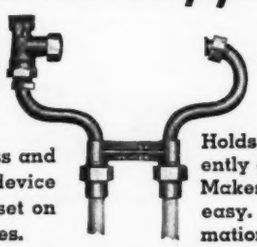

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Certificates of Competency for Waterworks Superintendents

Operators of Illinois water treatment plants have for several years desired the adoption of some plan by which they could receive licenses or some other form of certificate of competency. The State laws do not allow licensing, nor can the State Health Department require a certificate of qualification; but it can issue "certificates of competency," and it is now inaugurating a system for doing so. Obtaining these certificates is entirely optional with the operators and they have no legal status; but they serve as an indication of the operator's demonstrated ability and qualifications.

The issuance of these certificates is the fifth step in the department's planned program for improving waterworks operators, the others having been regular visits and inspections of the plants, receiving monthly operation reports, holding sectional and state-wide conferences on water treatment, and the issuance of a quarterly bulletin ("Over the Spillway") which is devoted to operation problems.

At the request of the operator's conference last fall, the department appointed a committee consisting of three operators, the chief sanitary engineer of the state health department and a member of the faculty of the state university, to prepare a classification and statement of qualifications to be used as a basis for issuing certificates. This provides for three classes of operators —A, B and C. Each must be at least 21 years old, have had a grammar school education or its equivalent, and show evidence of interest in the waterworks field. Class A shall be able to make or supervise the necessary laboratory plant control tests, including physical and chemical, and be generally familiar with laboratory procedure, technique, and interpretation of bacteriological analyses; be informed on the maintenance and operation of all mechanical equipment and devices in the plant, and be able to be responsible for and supervise plant operation. He shall have had five years' experience in operating the type of plant for which he is making application. Class B operators shall have had three years' experience in plant operation, sufficient knowledge of laboratory control tests, both chemical and physical, and their interpretation, and general knowledge of maintenance and operation of mechanical equipment and devices in his plant.

City's Water Rentals Not Transferable

The Ohio Supreme Court holds (City of Lakewood v. Hees, 132 Ohio St. 399, 8 N. E. [2d] 250) that under the state statute authorizing taxing authorities to transfer money from one fund to another, the revenues derived from municipally owned and operated waterworks may not be transferred to the general revenue fund of the municipality and be used to meet general governmental expenses and municipal obligations although the city purchased its water and owned and operated only a water distributing system.

Asphalt in Waterworks Structures

An article under this heading, which appeared in our March issue, contained two figures which were slightly incorrect, the author informs us. These should read as follows, the corrections being in italics:

"Iron Mountain Reservoir of the Metropolitan Water District of Southern California was given a 6-in. asphaltic lining in 1937 at a *construction* cost of *37¾* cts. per sq. yd. *exclusive of District engineering and administration charges* . . . The actual area of asphaltic lining in this reservoir is *51,498* sq. yd."

Methods of Resurfacing County Bituminous Roads*

By ERNEST H. COFFIN
Wayne County Road Supervisor, Richmond, Indiana

WHEN I became County Road Supervisor I found myself with a heritage of quite a number of miles of black-top surfaces which were costing an excessive amount in maintenance; some of them were constructed several years ago when the idea prevailed that a road should have at least a six-inch crown. In resurfacing some of these roads where maintenance was excessive, the surface was very uneven, the edges broken, and various heights of crown existed, we used the following plan: First, we would patch all holes, using a cold mix of ½ inch stone chips coated with A.E.S.3 in a concrete mixer. Then, after sweeping all loose sand and dirt from the edge of the road, we put on 1¼ inch of ½ inch chips, using a home-made spreader-box, built in the shape of a hopper, placed on runners with an adjustable back, and hitched to the rear of a truck. The truck, dumping slowly into the hopper, pulls it forward, leaving a windrow of the exact amount of stone necessary to provide 1¼ inches of loose stone over the road width. (We have found this very essential in all our work of constructing bituminous surfaces, as this makes for an even distribution of material and an even mix.) The stone is then spread to a width of approximately 16 feet. In all our mixing, we use a motor grader equipped with the oil turn blade. By spreading the stone before making the application of 5/10 of a gallon of A.E.S.2, we find that the mixing is much simplified as half the mixing is accomplished by penetration. We found in most cases that, after mixing, the middle of the road was so well coated with bitumen on the base that it needed no prime; but we usually prime each edge, using one spray bar, to insure that the surface was well prime coated before laying out the mix. The windrow is mixed just enough so that every particle of stone is thoroughly coated. The least amount of excessive turning tends to cause the material to set, and this must be guarded against by watching very carefully. The windrow is then flattened and split equally in two parts.

We then lay this out, one side at a time, with a Gledhill road shaper—an inexpensive attachment for any ordinary grader, which has a 24-foot straight edge which carries the inner end of the two blades and eliminates all waves, giving a uniform and smooth surface. It also has an attachment whereby any desired crown may be maintained by checking a spirit level.

Before laying out the surface, stakes are set to assure a straight edge and uniform width. The steering device of the grader with the attachment is set off center, directly behind the outer end of the blade, which makes it easy for the operator to keep a straight edge and uniform width. By the use of this machine, we have been able to get an entirely new, smooth-riding surface, regardless of the roughness and unevenness of the old surface.

After the material has been laid out, we roll immediately with a 5½-ton roller. Then the road is closed to traffic. The following morning, we apply to the strip previously laid 1/10 gallon per square yard of A.E.S.3, and cover with 10 pounds of buckshot pea gravel per square yard, and again roll. The road is kept closed to traffic from 1 to 3 days, according to weather and road conditions.

In the constructing of the road I have just described, the bituminous material used was two distinct grades of emulsified asphalt. We have obtained the same results by using flux oil and powdered asphalt, using approximately ¼ gallon less in the mix and using 25% by weight of powdered asphalt. (In making this explanation, I am not advertising any particular material, but am simply stating what we have used, and I would further say that I have no doubt the same results could be obtained by use of other bituminous material of proper specifications.)

After the road has been used for ten days or longer and the traffic has kneaded the material well together, we again apply 1/10 gallon per square yard of A.E.S.3. From the truck end-gate, approximately 12 pounds of refuse sand per square yard is then applied and the road is immediately opened for traffic. This gives a compact, waterproof, non-skid sand finish surface, which so far has shown no signs of peeling or picking loose, and we feel it will cut our maintenance cost to a minimum. We used 1½ gallons of bituminous material per square yard at 7½c per gallon. The stone chips cost $1.25 per cubic yard, and we used 300 cubic yards per mile for an 18-foot road. A mile therefore costs $1,563 for materials.

No doubt a lot of you men think such resurfacing costs too much money, but if it will eliminate continual patching and provide a smooth non-skid surface, regardless of unevenness of old road, then we believe it is far cheaper in the long run than some of the easier and cheaper methods.

By adding fine aggregate to fill the voids as I have described, the road surface shows not the least sign of peeling, while those with more open and less compact surfaces are peeling badly, and in many large spots the aggregate is half gone. This leads me to believe that in all bituminous surfaces, all voids should be filled to secure a surface as nearly waterproof as possible.

We are not attempting to do a large amount of new surface work, believing that, until more funds are available, we can better serve the whole county by spreading our money over our entire mileage, rather than spending excessive amounts on a few miles. I have been very much impressed by, and have given much consideration to, this statement, recently made in my presence: "If every road in the county could be black-topped free of charge, we could not afford to accept the gift, for the simple reason that we could not maintain them with the road funds we are now getting." However, by the use of cheaper materials, we can by careful planning maintain our roads and keep them passable for approximately 51 weeks in the year. We believe that unless a

* A paper presented at the Twenty-fourth Annual Purdue Road School, January 24-28, 1938.

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road has approximately 200 vehicle-miles of traffic per day, it can be maintained more cheaply as a gravel or stone road than with a bituminous surface.

Generally much work should be done on a road before the bituminous material is laid, for much of the success depends on the condition of the road before laying it. We have in most instances widened roads to be black-topped to a 50-foot right of way, reditching and regrading, and placing new culverts where needed. This should be done at least one or two years before the bituminous surface is laid. To the surface should be added from 300 to 500 cubic yards of good gravel per mile—where over 300 cubic yards is used, I would suggest two applications. This should be maintained with a planer-type machine from one to three times a week, depending on the amount of traffic, for a period of 6 months to a year. I am of the opinion that in doing this, we will have less trouble with our bituminous surfaces. We have had very good success with our mats following this type of preparation, using the exact equipment and practically the same process as described in our resurface work. Where you have thus prepared a road and have provided ample base and have good drainage, I have very little fear of the mat failing, even though it be a thin mat. At least, a thin mat will have more chances under these conditions than on a road having little or no base coupled with poor drainage.

On a road thus put in shape, and having been maintained until the base is well set and all culvert fills settled, we put the surface in shape by using a motor grader and Gledhill shaper, cutting the surface to the desired crown. We then prime by using at least .25 gallon of bituminous material per square yard, and close the road from 2 to 4 days. On a road thus primed, we would place a new mat exactly the same as the resurface described, using stone or washed gravel up to ¾ inch to the desired thickness wanted. In every case, we finish the surface with a finer aggregate, making it as near waterproof as possible.

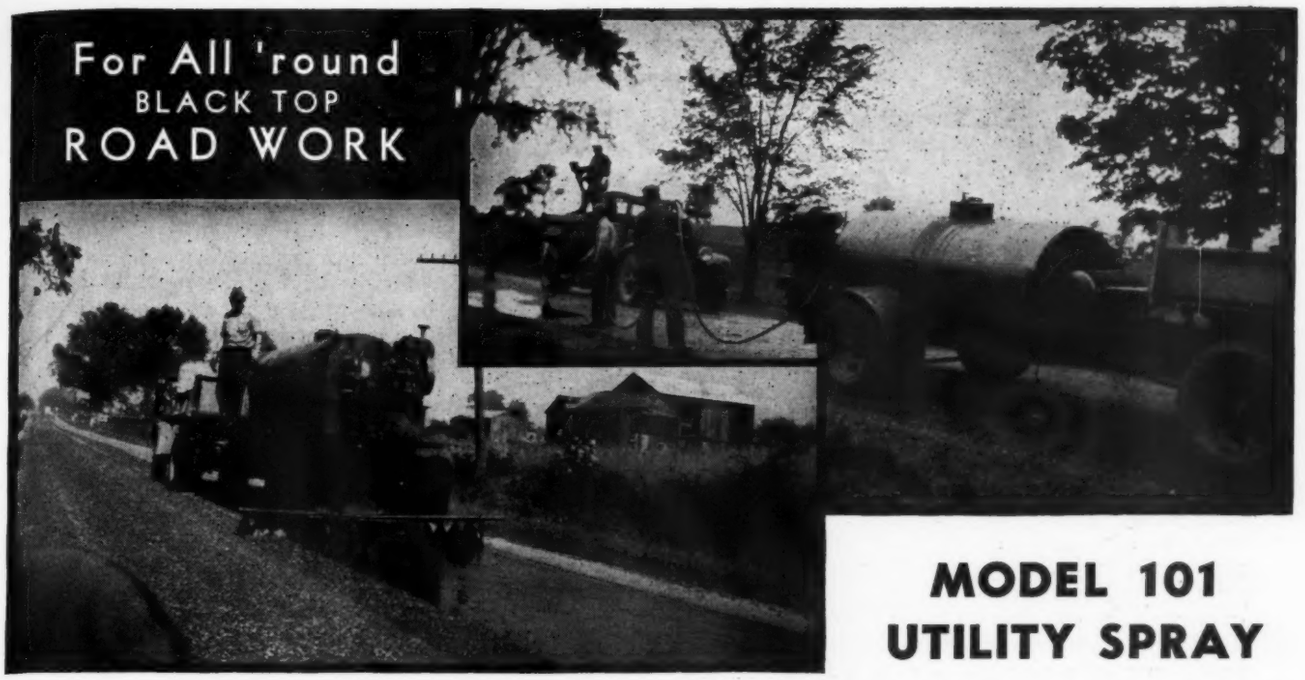
Your location geographically might justify a different plan; conditions differ, even on roads within the same county, but the basic principles will always be the same. They are:

1. You must have adequate drainage.
2. You must have enough base material, well compacted, to support your road.

I think most of us have made mistakes in attempting to build a black-top surface where we knew the conditions were unfavorable. This is caused a lot of times by influences beyond our control as road supervisors.

Claim Allowed for Rental Value of Highway Construction Machinery While in Disuse by State's Delay

On appeal from a judgment of the New York State Court of Claims in favor of the claimant and against the State for $20,223, the only question was the proper measure of damages for the loss of use of the claimant's highway construction machinery and equipment. This had been caused to remain idle by the delay of the State in obtaining the requisite rights of way. The number of days that each piece of equipment was out of use because of such delay was conceded in the court below. The claimant showed the reasonable rental value per day of such equipment. The State offered no testimony to contradict the figures given by the claimant's experts as to rental value. The New York Appellate Division, Immick Co. v. State, 297 N. Y. S. 623, therefore affirmed the judgment.



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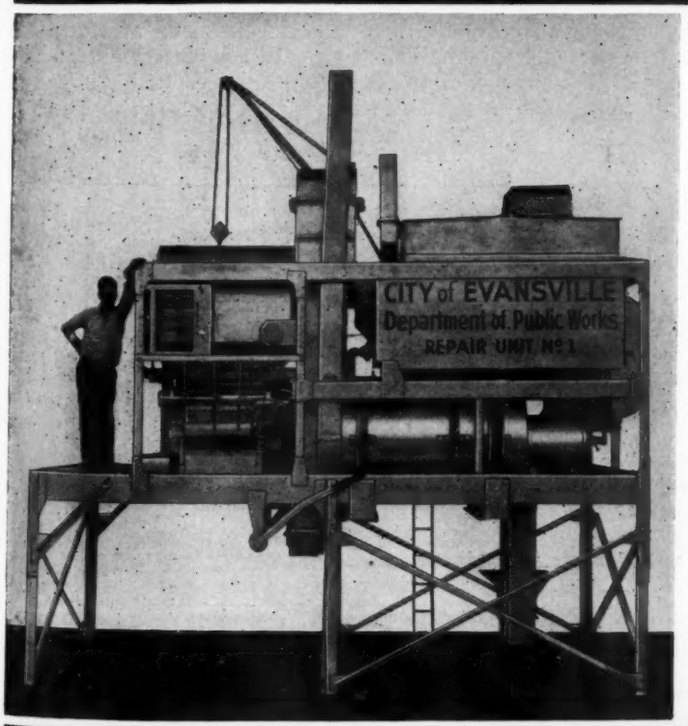

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Following is a digest of the important articles published last month having to do with water works design, construction and operation and water purification, arranged in easy reference form.

The Water Wheel

Bituminous coatings for cast iron and steel pipe have been so improved in recent years that manufacturers could now, it is said, guarantee pipe which they coat against corrosion, inside or out, for an indefinite time. Cold coatings are worthless for preventing underground corrosion; hot coal-tar enamels are generally the best type of protection yet found. Spun bituminous linings are not difficult to apply if the temperature and cleanliness of the pipe are right. Coatings of similar material offer protection against soil corrosion if not damaged by handling or by cinders, sharp gravel, sea shells, etc., in the soil, or by soil stress which tears cracks in it. Such damage is guarded against by wrapping the pipe with felt or asbestos saturated with tar. In any case, the coating or lining should be tested for pinholes by an electric holiday detector (a Neon-sign transformer delivering 15,000 volts at 50 milliamperes to a wire brush passed over the coated surface).

As further insurance, and in the case of pipe already laid with more or less imperfect coating, cathodic protection may be used (see *Water Wheel* for March), although its application on a city distribution system would require the services of an expert. It may be that in the near future coating manufacturers will "assume complete liability for the protection of the pipe line by making the necessary soil surveys, recommending the proper type of protection for that soil, and deciding whether cathodic protection should be adopted or not, applying the coating himself and then furnishing a maintenance agreement guaranteeing the freedom of the pipe line from leaks due to corrosion."[B7]

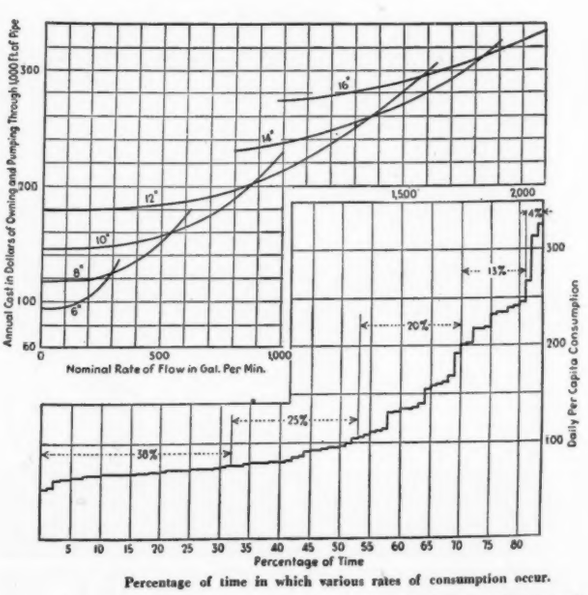
Sizes of mains for the distribution system of Highland Park, Tex., were determined by calculating, for each location, the annual cost of owning a given size of main (amortized for life of 100 yrs.) and the annual cost of pumping through it, taking into account the length of time water would be pumped at each rate. The latter was obtained by use of records of the percentage of time consumption per capita continued at each rate. Curves showing the combined cost of owning and pumping through each of the several sizes of pipe for each nominal rate of flow were plotted. Where a curve of one size intersects that of the next larger shows where economy calls for change to the larger size.[E22]

Water meters can be made by the Minneapolis water department at one-third less than the ordinary bid prices, but it continues to purchase them. "All meter patents expired years ago so that meter makers have only price, quality and service advantages over any well-equipped machine shop.[E24]

Alga activity in Southern California has been found apparently to vary with the ultra-violet ray radiation from the sun; periods of greatest microscopic growths in reservoirs occur when ultra-violet radiation is greatest and water temperature and hours of sunshine low. Los Angeles uses ultra-violet ray measuring devices, and when activity of such rays is on the increase the reservoir dosing with copper sulphate or chlorine is increased; while when ray activity is on the decrease, even though microscopic counts are somewhat high, treatment is postponed. Applying this method, there has been a saving of 20% of chemicals used in treating reservoirs, but the water has had greater freedom from tastes and odors.[E25]

Well screen slots should be selected as to size by analyzing the sand in which the well is driven or the gravel with which it is packed. A Wisconsin city 25 yrs. ago drove twenty 10″ wells without such selection, which yielded 350 gpm with 26 ft. drawdown. Twenty years later the old screens were replaced with others having scientifically selected slots, and yielded 770 gpm with 24 ft. drawdown, or nearly 2½ times as much per foot of drawdown. If this had been done in the first place, $13,870 would have been saved in pumping costs.[W3]

Submersible deep-well pumps are being produced by three American manufacturers—standard deep-well turbine elements directly connected to a motor designed to operate submerged in water. In one the motor windings are encased in a stainless steel shield with hydraulic, grease-packed ball bearings, water entering the motor housing for cooling purposes; motor efficiencies are considerably lower than standard conventional motors. In another, the complete motor is enclosed in a cylinder filled with a dielectric oil, the entrance of water being prevented by means of a compression-grease-packed stuffing box. The third is somewhat similar but uses a rotating mercury seal to exclude the water; a volatile oil being used as a dielectric which, under a slight heat, forms a gas at the motor armature gap; an hydraulic balancing tube equalizes the pressure in the motor casing. All develop remarkably high horsepower in small diameter frames due to the cooling effected by the surrounding water.[K3]



Percentage of time in which various rates of consumption occur.

Engineering News-Record

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Iron removal by lime at Flushing, N. Y., has been practiced for four years, pumping through a pressure filter without oxidation. Lime hydrate applied removed the iron as ferrous carbonate; this and calcium carbonate adhered to the sand, expanding the volume a foot in height (27" of sand to 39") in two years. By operating without lime for a time the sand returned to its original depth, but the hardness increased to 90 ppm. During 1937 the procedure was to discontinue feeding lime until iron in the filtrate increased to 0.4 or 0.5 ppm (determined by a simplified colorimetric test), when lime feeding was renewed. Lime discontinuance varied from 2¾ to 5¼ hrs. in length about once a week, or 4 hrs. a week. This treatment reduced the iron from about 2.7 ppm to 0.24, and free CO_2 from 34.0 to 0.3 ppm; and increased hardness from 24 to 47 ppm (calcium carbonate), alkalinity from 11 to 45, and pH from 5.7 to 7.9.[F30]

Leak detection in New York is effected by eight field parties of 3 men each, under 8 engineers and foremen, 32% of their time being devoted to leak surveys. It is assumed that leaks so discovered would have continued an average of 2 yrs. longer before being learned of in some other way (believed to be very conservative). On this basis, discovery and stoppage of leaks has cost $3 per mg saved. Amount of leakage is calculated by considering area of crack, etc., as an orifice, using 0.60 as coefficient; the reasonable accuracy of which has been checked frequently by actual measuring of discharge with scales and stop-watch, pitometer, etc.[F32]

Carbon dioxide reduction is secured at Dillsburg, Pa., by passing the water through beds of limestone, screened to ¾-1½ in. size. A bed 55 x 5 ft. by 4 ft. deep is used for 50,000 gpd, divided into 3 sections by baffles which induce up and down flow through the

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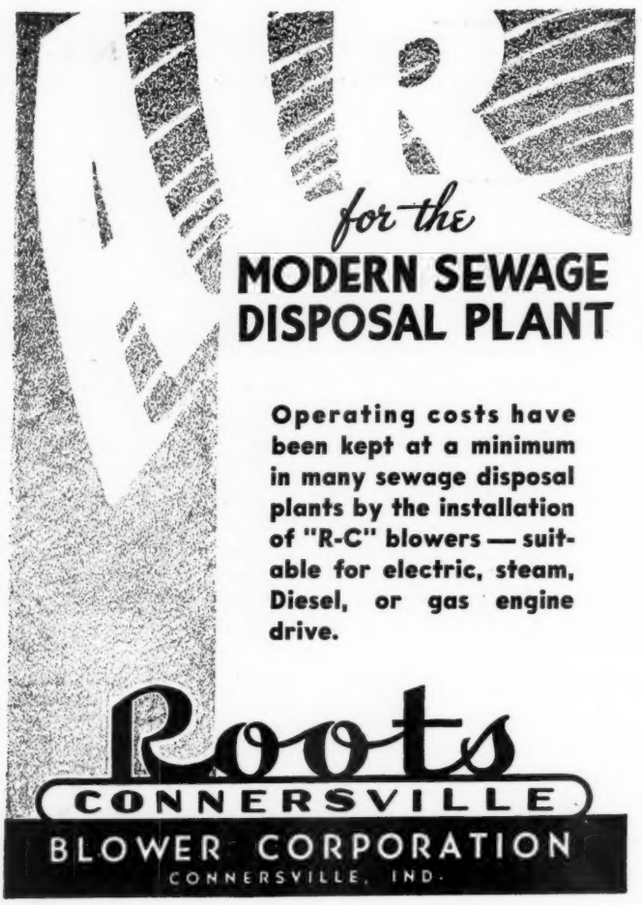
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limestone. Limestone in the first third has lost about one-twelfth its volume, indicating solution by the water of about 200 lb. per million gallons. Contact period of 3½ hrs. reduces CO_2 from 20 ppm to 5, and increases pH from 5.4 to 7.3, alkalinity from 12 ppm to 44, and hardness from 8 ppm to 40. Iron and other metallic tastes at the taps have been removed, also iron stains and deposits, and frequency of cleaning service meters has been greatly reduced.[G19]

Welded steel pipe, 60″ diameter, laid with Dresser couplings in St. Louis in 1936, was tested under heads up to 297 ft. and showed a leakage of 2.74 gal. per inch-mile, after correcting leaks at manhole gaskets and valves. The specifications allowed 125 gal. Similar pipe laid in 1937, with a leakage limit of 5 gal., tested 0.39 gal.[F35]

Chlorine-ammonia treatment of Hetch Hetchy water by San Francisco, in the largest plant of the kind in the world (capacity 2,000 lb. of chlorine, 400 lb. of ammonia a day) is for disinfection but more importantly for control of filamentous biological growths which have developed in the tunnels along the equeduct, including crenothrix and beggiatoa, which depleted the dissolved oxygen content of the water and at times produced noticeable taste and odor, and reduced the carrying capacity of the equeduct. Copper sulphate and lime had been tried as remedies but were unsatisfactory. Treatment using between one and two ppm of chlorine, 0.2 to 0.4 ppm of ammonia has been successful. Equipment used, two 1,000 lb. per day, manually controlled, W & T master vacuum chlorinators, and two W & T ammonia machines with injectors.[G17]

Bibliography of Recent Waterworks Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c, Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

A *Journal, American Water Works Ass'n.*

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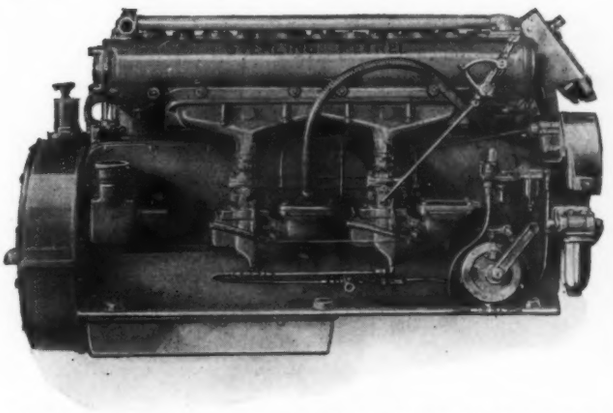

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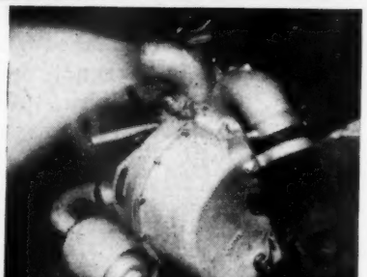

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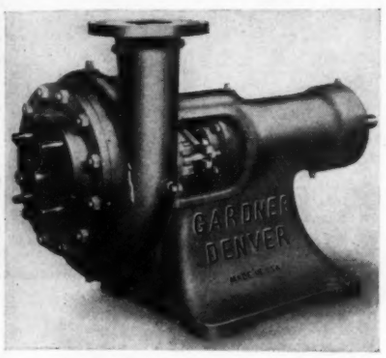

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Accelator Water Softener

THE Accelator has been developed by International Filter Co. for water softening. In this, it is said, the principles of mass action and catalysis are combined with a new and more rapid method of clarification, which results not only in softening but also in stabilization, iron removal, pH adjustment, etc.

Raw water introduced into the reaction chamber of the Accelator is mixed there with circulating slurry of previously precipitated solids and the proper dose of whatever chemicals the treatment requires. New solids are formed in the reaction chamber in the presence of the depositing surface of the circulating sludge particles, as a result of which, the reactions involved are hastened, and a large portion of the new solids is deposited on the old particles, instead of forming as new small ones.

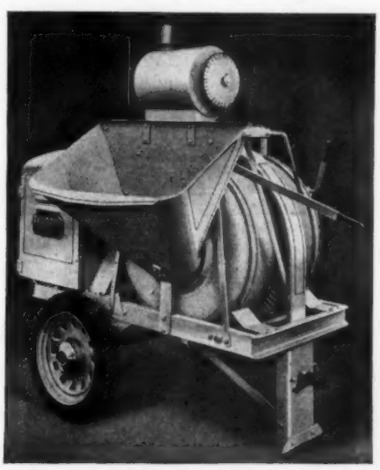
Time and space requirements are reduced by the rapidity with which reactions and clarification take place, and approximately one-fourth the usual area and volume of tanks provided for mixing, coagulation and sedimentation is required. International Filter Co., 59 E. Van Buren St., Chicago, Ill., will send further information on request.

The B-G Tamping-Leveling Finisher

No-Wait — Light-Weight, Non-Tilt, Handy Mixer

LATEST addition to the Jaeger Machine Company's concrete, mortar, and plaster mixers is this light-weight "Handy" non-tilt trailer said to have a capacity of 30 to 40 cubic yards a day. This high capacity is due to the measuring batch hopper, which is of the same capacity as the drum, and can be loaded while the previous batch is being mixed and discharged, thus eliminating waiting between batches as well as saving the cost of a power loader.

Drum design is like that of larger Jaeger mixers, with a criss-cross remixing action. Buckets are large for fast discharge. Chilled drum rollers operate on ball bearing shaft. Water tank is syphon type, of 7 gallons capacity, with quick setting dial. All controls are on side opposite from engine, which is 2½ hp. fully enclosed.



New Jaeger Mixer

B-G Tamping-Levelling Finisher

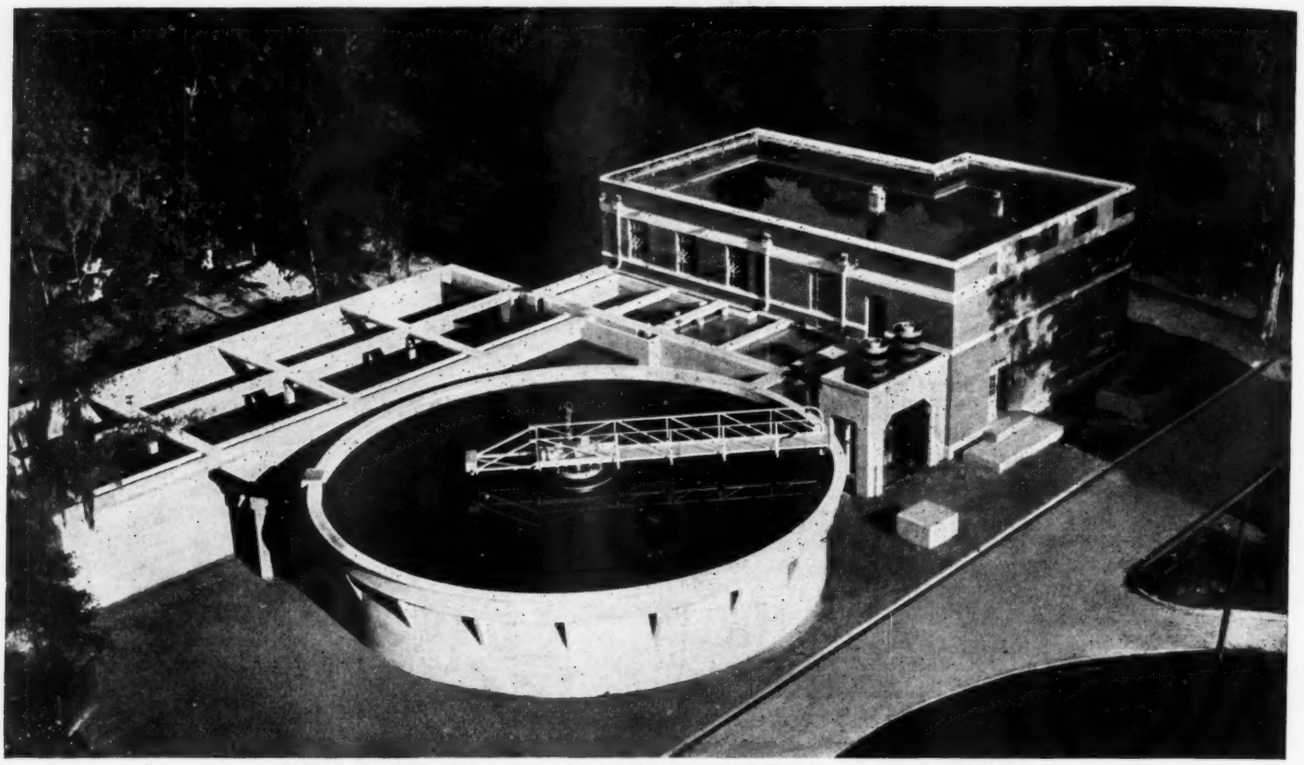
The new Tamping-Leveling Finisher by Barber-Greene automatically levels without forms, spreads, lays to grade, and compacts simultaneously. Its tamping gives a permanent uniform density which reduces and simplifies rolling and which will not reflect sub-grade irregularities under rolling or traffic. It makes possible very thin courses, opening up a new field in resurfacing worn out pavements. Thickness and crown are under complete control, can be changed easily while operating and ingeniously reflected in such a manner that abrupt changes are absolutely impossible. The machine normally lays 10′ wide, but cutoff plates can quickly be attached for 8′ or extensions added for 12′. In laying adjacent strips, the machine matches joints perfectly. It can lay flush to the curb.

In laying a smooth surface over an irregular sub-grade, a mat of varying thickness is necessary. Since it levels and compacts simultaneously, the machine automatically feeds the correct amount of material for the level compacted thickness, filling depressions with the extra needed material. The leveling principle is based on the delayed response of the screed to the crawlers' up or down movement over base irregularities, at the same time maintaining the proper thickness.

Thickness, crown, and super-elevation are all easily and quickly adjusted while operating. The principle of these adjustments is tied in to the leveling principle in such a way that alterations are slowly reflected in the finished surface. Abrupt changes are impossible.

For unworkable, dead, or extremely lumpy material, an agitator may be added. For extremely tacky material, the screed may be heated. Being crawler mounted, the finisher is extremely flexible and can turn in its own width.

Information without obligation from Barber-Greene Company, Aurora, Ill.



Settling tank of water softening plant, St. Augustine, Florida. Equipped with final type Circuline Collector. Robert & Co., Inc., Atlanta, Ga., Consulting Engineers.

STRAIGHTLINE SLUDGE COLLECTION *for* ROUND TANKS WITH THE CIRCULINE COLLECTOR

The Link-Belt CIRCULINE Collector provides round tanks with the same important features which have made the STRAIGHTLINE Collector the acknowledged standard for rectangular tanks.

A Circuline equipped tank is provided with a revolving bridge carrying a sludge plow and a STRAIGHTLINE conveyor which positively delivers the settled solids into an annular covered sludge trough from which it is withdrawn. The entire floor of the tank is cleaned of settled solids during each revolution of the bridge, thereby permitting extremely slow movement of the bridge and conveyor, which insures minimum disturbance of settling and settled solids. Send for Book No. 1642.

FLOCCULATION TANK EQUIPMENT

Link-Belt mixers of the vertical or horizontal type have proved their value in reducing chemical costs and promoting efficient coagulation.

LINK-BELT COMPANY PHILADELPHIA, CHICAGO, LOS ANGELES, TORONTO

Offices in principal cities

7354

LINK-BELT

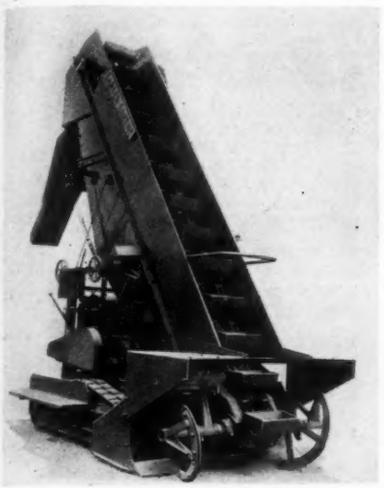
SCREENS ▲ COLLECTORS ▲ AERATORS ▲ GRIT CHAMBERS ▲ DIFFUSERS

When you need special information—consult the *classified* READERS' SERVICE DEPT., pages 55-57

KEEPING UP WITH NEW EQUIPMENT

Barber-Greene Junior Bucket Loader

A NEW crawler-mounted, self-feeding bucket loader, the Model 552, has been announced by Barber-Greene Company, Aurora, Ill. This is said to provide the cheapest means of loading



Junior bucket loader.

bulk material — sand, gravel, crushed stone, earth, coke, cinders, etc., from ground storage to trucks.

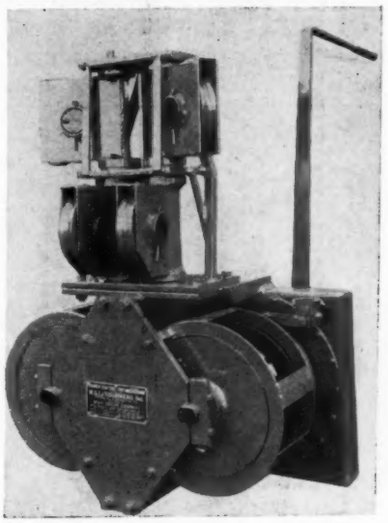
The bucket loader operates continuously, giving a steady flow of material; spirals are self-feeding; operation is simple. Being crawler-mounted, is quickly moved from one set-up to another within the yard or pit, and its boom may be laid back for low traveling clearance for covering greater distances.

Complete information will be sent to any one writing Barber-Greene Company, Aurora, Illinois.

A Scraper for County Work

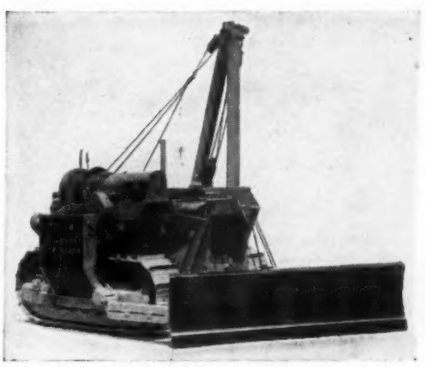
PLENTY of work for a medium scraper in most counties (and also for most contractors). This is a 6-yard unit. It will dig and haul; it will spread its load accurately, as desired, in layers from 1 inch to 15 inches thick. It will cut a ditch or back slope. Handled by a

This Calyx core drill is described in a 42-page catalog. This drill cuts cores from 2¼" diameter up for highway testing, well drilling, etc. Data on request to Ingersoll-Rand, Phillipsburg, N. J.



New double-drum power control unit, by Le Tourneau, is designed for Caterpillar D8 tractors. Line pull is 9,600 lbs.; cable capacity is 255 ft. of ½", 6 x 19 cable on each drum.

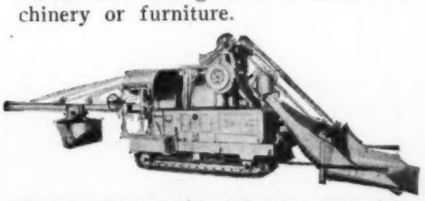
45 or 50 hp. tractor. Operated by the tractor driver. For fuller information write R. G. LeTourneau, Inc., Peoria, Ill., about the G-6 scraper.



A Trackson Equipped Unit

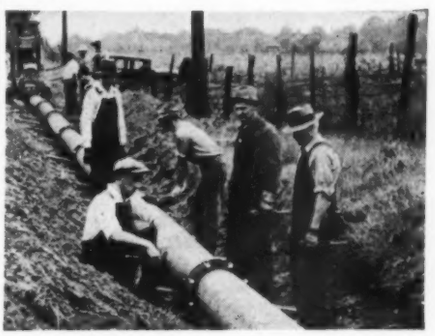
A Floor Sweeper

THE Foote Company, Inc. of Nunda, N. Y., has added a new floor sweeper. This is a compact unit that travels under its own power and is guided much like a lawn mower. It is of a combined brush and vacuum type and is absolutely dust-less. This means the complete removal of dirt from the floor into containers which can be removed, dumped and cleaned. Sweeping can be either wet or dry. A wall brush is provided for cleaning walls or under machinery or furniture.

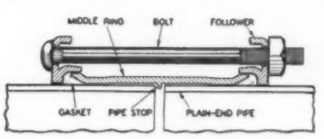


The new Ransome dual drum paving mixer, 27 cubic feet capacity, made by Ransome, Dunellen, N. J.

NO LOST MOTION WITH DRESSER PIPE JOINTS— EVERYTHING GOES LIKE CLOCKWORK!



"Straight-line" production best describes the way a Dresser-coupled line is laid. ● All operations are uniform, speedy, and "in step." The small, well-bunched laying and jointing crew is always "up" with the trencher! There's no lag between operations! Joint-making—mostly a matter of tightening a few bolts—is done the *same* way every time. All the work moves forward as a unit!



Cross section, Dresser Steel Coupling, Style 38, showing how it joins *plain-end* pipe in a *flexible*, yet permanently tight connection. Sizes available: ¾" I. D. to largest pipe made.

DRESSER
PIPE COUPLINGS

S. R. DRESSER MANUFACTURING COMPANY
BRADFORD, PA.
230 Park Avenue, New York, N. Y.
Peoples Gas Building, Chicago, Ill.
Shell Building, Houston, Texas
1038 Polk Street, San Francisco, Calif.
In Canada: Dresser Manufacturing Co., Limited, 60 Front Street, West, Toronto, Ontario

The American Water Works Association

The 58th annual convention of the American Water Works Association was held at New Orleans, La., April 24 to 28. As usual, there were many excellent papers and discussions, and enough entertainment to keep the technical sessions from being too technical. Attendance was good, with some 1100 registrations.

Reeves Newsom, consulting engineer of New York, was elected president of the Association, succeeding Eugene F. Dugger. The 1939 convention will probably be held at Atlantic City, N. J.

The Diven Memorial Medal was awarded to William C. Mabee, chief engineer of the Indianapolis Water Co. for outstanding work during the past year. To Vance C. Lischer was given the Goodell Award for his paper on "Water Hammer."

H. W. Ford, Pittsburgh-Des Moines Steel Co., was elected president of the Water Works Manufacturers Association, succeeding Clint Inglee, and Ed. Johnson of the Pittsburgh Equitable Meter Co., vice president. Edgar Buttenheim of *American City* was reelected treasurer, and John Kienle, Mathieson Alkali Works, was reelected secretary.

Richard G. Hext is the new advertising manager of Littleford Bros., Cincinnati, O., makers of road maintenance equipment.

Making Trucks Earn 50% More With the Load Lugger

Trucks don't earn much while they are being loaded, and the Brooks Load Lugger is designed to eliminate time losses in loading. The illustration herewith shows what it is. Operated by direct drive from power take-off to hydraulic pump hoist. Bucket carried by truck itself, and not by suspension. Good load distribution. Easily mounted on any truck. No side sway. Instant dumping without leaving truck.

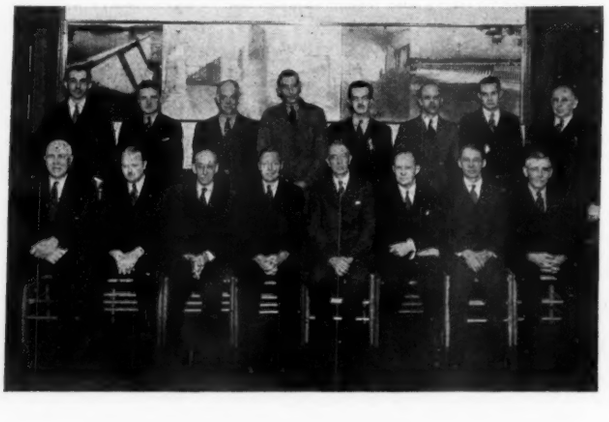
One truck can service 5 to 10 buckets. On one quarry, one 1½-ton truck is now handling 7 1½-ton buckets and hauling 250 yds. per day. This one truck replaced 4 1½-ton trucks; three truck drivers were dropped, and the operations of three trucks saved, but nine bucket loaders were added. Production stepped up 50%.

How the Brooks Load Lugger works

Designed for busy and narrow streets, sewer work, loading of sand, gravel and stone, etc. For fuller information, write Brooks Equipment and Mfg. Co., Knoxville, Tenn.

New York Sewage Operators Train at Cornell

Seated, left to right: Albert Forbes, Watkins; C. C. Agar; Professor H. N. Ogden; Dean S. S. Hollister; director P. H. Underwood; Professors William E. Stanley and C. L. Walker; and Fred McLaughlin, Herkimer. Standing, left to right: R. H. Kessler, Boonville; Lloyd Blood, Rome; Carl Harvey, Irondequoit; James T. Lynch, Auburn; Richard Weisbeck, Alden; John Slough, Wellsville; Reginald Murphy, Willard; and H. D. Hutcheson, Newark.



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Readers' Service Department

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These booklets are FREE to readers of PUBLIC WORKS.

Feeders, Chlorine and Chemical

387. For chlorinating small water supplies, swimming pools and other installations. Flow of water controls dosage of chlorine (or other chemicals) providing required dosages, which are immediately adjustable. Driving is started and stopped automatically. Send for newest literature. %Proportioneers%, 9 Codding St., Providence, R. I.

Filter Plant Controllers

388. "The Modern Filter Plant" and the uses of Simplex Controllers for operation are described in a handy, 16-page booklet. Charts, data, curves and tables. Simplex Valve and Meter Co., 68th and Upland Sts., Philadelphia, Pa.

Flow Meters

389. The primary devices for flow measurement—the orifice, the pilot tube, the venturi meter and others—and the application to them of the Simplex meter are described in a useful 24-page booklet (42A). Simplex Valve and Meter Co., 68th and Upland Sts., Philadelphia, Pa.

Gate Valves and Hydrants

390. An 84-page catalog gives full design data, information about and illustrations of the complete line of Darling Gate Valves and Hydrants. Write for one to Darling Valve and Mfg. Co., Williamsport, Pa.

391. Two new bulletins on M-H fire hydrants and fully bronze mounted gate valves are now ready. Contain full specifications and instructions for ordering, installing, repairing, lengthening and using. Write M. & H. Valve & Fitting Co., Anniston, Ala.

392. 28 page catalog contains illustrations and complete specifications of M-H standard and extra heavy iron body gate valves, horizontal swing check valves, flanged fittings and flanges, etc. Sent promptly on request by M. & H. Valve & Fittings Co., Anniston, Ala.

Manhole Covers and Inlets

403. Nuisance from loose, noisy manhole covers is eliminated by the use of Westeel rubber cushioned manhole covers and gratings. Six special advantages are explained in a new illustrated bulletin just issued by the West Steel Casting Co., 805 East 70th St., Cleveland, Ohio.

404. Street, sewer and water castings made of wear-resisting chilled iron in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter, crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co., South Bend, Ind.

Pipe, Cast Iron

406. Data on cast iron pipe for water works systems, in sizes from 1¼ to 84 inches, including information on useful life, flow data, dimensions, etc., Thos. F. Wolfe, Cast Iron Pipe Research Ass'n, 1013 Peoples Gas Bldg., Chicago, Ill.

Pipe, 2-inch Cast Iron

407. The new McWane 2" cast iron pipe in 18-foot lengths has innumerable uses in water and sewage work. Send for the new McWane bulletin describing this pipe, the various joints used, and other details about it. McWane Cast Iron Pipe Co., Birmingham, Ala.

Pipe, Large Cast Iron

408. Handy cast iron pipe and fittings catalog contains A.W.W.A. and A.G.I. standard specifications for a wide variety of cast iron pipe specialties, both bell and spigot and flanged; also dimensions Lynchburg Foundry Co., Lynchburg, Va.

409. Information on concrete pipe for sanitary or storm sewers which can be made anywhere by manufacturer using local labor and materials. Write Concrete Pipe Machinery Co., Sioux City, Iowa.

Pipe Forms

411. Making concrete pipe on the job to give employment at home is the subject of a new booklet just issued by Quinn Wire and Iron Works, 1621 Twelfth St., Boone, Ia., manufacturers of "Heavy Duty" Pipe Forms. Sent promptly on request.

Pipe Joints

412. New folder describes in detail a new type of pipe joint—the Dresser Compression Coupling Style 65, which is compact and self contained, makes a permanently tight joint under all conditions and is installed on plain end pipe in a few seconds with only one tool, a wrench. Get your copy today. S. R. Dresser Mfg. Co., Bradford, Pa.

Taste and Odor Control

417. How, when, and where activated carbon can and should be used to remove all kinds of tastes and odors from water supplies is told in a new booklet just issued by Industrial Chemical Sales Div., 230 Park Ave., New York, N. Y. 32 pages, table, illustrations and usable data.

418. Information on activated carbon for taste and odor control including data on operating experiences. Write L. A. Salamon & Bro., 216 Pearl St., New York, N. Y.

Pumps and Well Water Systems

420. Installation views and sectional scenes on Layne Vertical Centrifugal and Vertical Turbine Pumps, fully illustrated and including useful engineering data section. Layne Shutter Screens for Gravel Wall Wells. Write for these three descriptive booklets. Layne & Bowler, Inc., Dept. W, General Office Memphis, Tenn.

Pumping Engines

424. "When Power Is Down," gives recommendations of models for standby services for all power requirements. Sterling Engine Company, Buffalo, N. Y.

Run-off and Stream-Flow

425. Excellent booklet describes and illustrates the latest types of instruments for measuring run-off, both from small areas for storm sewer design, and from large areas for determining water shed yield. Sent promptly by Julien P. Friez & Sons, Baltimore, Md.

Screens, Sewage

428. Be assured of uninterrupted, constant automatic removal of screenings. Folder 1587 tells how. Gives some of the outstanding advantages of "Straightline Bar Screens" (Vertical and Inclined types). Link-Belt Co., 307 N. Michigan Avenue, Chicago, Ill.

Setting and Testing Equipment for Water Meters

430. All about setting and testing equipment for Water Meters—a beautifully printed and illustrated 40 page booklet giving full details concerning Ford setting and testing apparatus for all climates. Ford Meter Box Co., Wabash, Ind.

Rainfall Measurement

432. The measurement of precipitation, exposure of gauges, description of apparatus for measuring rainfall, both rates and amounts. Bulletin RG and Instruction Booklet. Julien P. Friez & Sons, Baltimore, Md.

Screens

435. Water Screen Book No. 1252, describes traveling water intake screens and gives complete technical information about them. Link-Belt Co., 307 No. Michigan Ave., Chicago, Ill.

Sewage Filters, Magnetite

436. Well illustrated booklet describes the magnetite filter, and tells how it is used in the treatment of Sewage. Copy on request from Filtration Equipment Corp., 10 East 40th St., New York, N. Y.

Small Septic Tanks

438. Septic Disposal Systems, Waterless Toilets, Multiple Toilets for Camps and Resorts, and other products for providing safer sewage disposal for unsewered areas are described and illustrated in data sheets issued by San-Equip, Inc., 700 Brighton Ave., Syracuse, N. Y.

Sludge Incineration

440. Disposal of Municipal Refuse: Planning a disposal system; specifications. The production of refuse, weights, volume, characteristics. Fuel requirements for incineration. Suggestions for plant inspection, 45 pp., ill. Also detailed outline of factors involved in preparation of plans and specifications. Morse-Boulger Destructor Co., 202P East 44th St., N. Y.

Swimming Pool Equipment

444. A new booklet "Essential Factors in the Design and Layout of Swimming Pool Systems," with data on filtration equipment, fittings, solution feeders, accessories, etc., is available from Everson Manufacturing Co., 213 West Huron St., Chicago, Ill.

445. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data, prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

446. 40-page Manual on swimming pools. Includes swimming pool layouts, specifications, etc., and details concerning Permutit Swimming Pool Equipment. Write The Permutit Co., Dept. G-4, 330 West 42 St., New York, N. Y.

Treatment

450. Standard Sewage Siphons for small disposal plants and PFT Rotary Distributors are new catalogs recently issued by Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago, Ill. The latter catalog contains typical plans and many illustrations of actual installations.

453. New booklet on Link-Belt Circuline Collectors for Settling Tanks contains excellent pictures and drawings of installations, sanitary engineering data and design details. Link-Belt Company, 307 North Michigan Ave., Chicago, Ill.

454. Full information regarding their newest equipment for sewage treatment and water purification will be sent on request by The Dorr Co., 570 Lexington Ave., New York, N. Y.

Water & Sewage Treatment Chemicals

500. Aluminum sulphate and ferric chloride for sewage coagulation, and these chemicals and ammonia, copper sulphate and others for water treatment. Information on uses and methods sent on request to General Chemical Co., 40 Rector St., New York, N. Y.

501. "Ferrisul for water and sewage treatment." What it is; what it will do for you and how to use it—a handy booklet issued by Merrimac Chemical Co., Everett Station, Boston, Mass.

Valve Box Tops

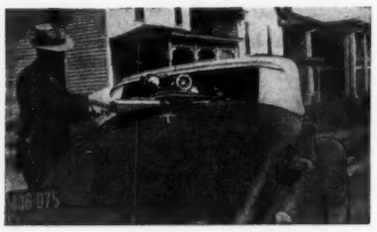
475. "Cut the Cost, but Not the Pavement," is the theme of a new bulletin on Rite-Hite Valve Box Tops. Gives directions for forming new tops on valve boxes, quickly and inexpensively without digging up the old box. Just issued by Trohn's Supplies, Inc., 205 Hoyt Ave., Mamaroneck, N. Y.

Water Works Operating Practices

490. "What Is New In Coagulation" is an excellent, new review with bibliography and outlines of latest work done in the field. Written by Burton W. Graham and sent free on request to Activated Alum Corp., Curtis Bay, Baltimore, Md.

% CHEMICAL FEEDERS %

Are YOU ready for Flood Emergencies?

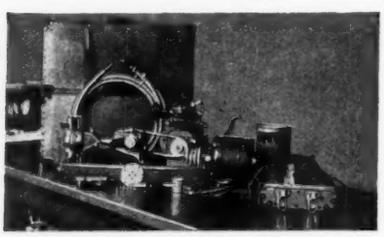


Board of Health Emergency Unit—with 1/5 H.P. gasoline engine and interchangeable 1/6 H.P. electric motor.

Orders already received from the California flood areas have found %Proportioneers% ready in 1938 — as they were in the floods of '37 and '36— to serve water works and public health authorities with Chlor-O-Feeder equipment in the quickest possible way.

Chlor-O-Feeders are ideal for emergency service in that they are: 1. Shipped from stock; 2. Small—easy to carry; 3. Easy to install; 4. Immediately effective in making water safe; and 5. Low priced.

Remember that quick action and dependable hypo-chlorinators are most important in preventing disease epidemic following a flood. Many communities play safe by keeping a few portable Chlor-O-Feeders on hand for immediate use in any kind of emergency!



Board of Health Portable Emergency Unit easily fits into car—ready for use anywhere.

For EMERGENCY service wire—or call Providence Gaspee 4302

% PROPORTIONEERS % Inc.

Associated with Builders Iron Foundry

9 N. Codding Street
PROVIDENCE, R. I.

For the Engineer's Library

Brief reviews of the latest books, booklets and catalogs for the public works engineer.

HTH Dosage Tables:

A reprint of a portion of the 3rd Edition of Hypochlorination of Water, by Savell of Mathieson. Table I shows amount of HTH required to treat different volumes of water. Table II shows the weight of HTH required to make up solutions with available chlorine strengths of ½% to 10%. Table III gives the dosage obtained with 1 gal. of these various solutions. Table IV, the volume of 1% solution to give a treatment of 1 p.p.m. Table VI gives proper dosages for sterilizing new mains. This 8-page reprint is handy to have around. Write Mathieson Alkali Works, 60 East 42nd St., New York, for a copy.

Pneumatic Remote Transmission:

A folder is available on this subject from Brown Instrument Co., Wayne and Roberts Aves., Philadelphia. Ask for Folder 94-1. This system was developed for remote transmission of measurement and control in hazardous atmospheres, where the use of electrical transmission is not permissible. Diagrams illustrate principles involved.

Floc-Former:

An instructive booklet has been issued by Permutit Co., N. Y., on their Floc-Former. Subjects treated include principles of coagulation; pH control, mechanical agitation, use of clay or recirculated floc, design features, typical layouts, etc. Excellent drawings. Sent on request.

Soft Water:

This is a non-technical presentation of the need for and advantages of soft water, both interesting and educational. 16 pages. Sent on request to Permutit Co., New York, N. Y.

Facts and Figures:

A mighty handy vest pocket size 48-page book by Pioneer Engrg. Works, Minneapolis, Minn., in which 46 pages are sure-enough data and 2 pages only illustrate Pioneer products. Tables of all kinds, dope on crushers, power requirements, coarse aggregate requirements and 65 other subjects. Sent on request.

Joint Pipe & Fittings:

A very handy data book, and unusually attractive. Explains the U. S. mechanical joint in detail, illustrates the six steps in assembly, and shows installations. Includes standard specifications for U. S. Joint centrifugally cast iron pipe. Gives joint dimensions and weights; also weights and detail dimensions of bends, tees, crosses, offsets, reducers, wedges, sleeves, caps and other fittings. Excellent for reference and exceptionally kind on the eyes. Sent on request. U. S. Pipe & Foundry Co., Burlington, N. J.

Sodium Chloride Stabilization:

Developments in Road Stabilization with Sodium Chloride, by Dr. C. D. Looker, is being distributed by International Salt Co., Ithaca, N. Y. This is an illustrated 18-page text. It includes a discussion by R. M. Rowat of Canadian developments. Sent on request.

Traffic Engineering:

A traffic engineering notebook, 224 mimeographed pages, containing outlines and lectures presented at the first traffic engineering school at Harvard; contains 37 summaries or address; being sold for one dollar. Bureau for Street Traffic Research, Cambridge, Mass.

Road Rollers:

An unusual catalog covering the complete line of Buffalo-Springfield rollers. Excellently arranged and prepared: 24 pp. Illustrates 3-wheel rollers, the 14 and 16-ton; the 12-ton diesel; the 10-ton; the 5-7 ton; the 8-ton; the 3-axle 14-19-ton tandem; and the tandems of 15-21 tons, 10-14½ tons, 7-10½ tons, 5-7 tons, 3 to 3½ tons and 2 to 2½ tons. Sent on request to Buffalo-Springfield Roller Co., Springfield, O.

Engines and Power Units:

Allis-Chalmers, Tractor Division, Milwaukee, Wisc., has issued a 24-page booklet describing their power units; curves and technical data covering torque, horsepower and fuel consumption; also specifications. Sent on request.

30 Construction Jobs:

Thirty construction jobs are illustrated and explained in this booklet, ranging from those involving the simple fresno up to those employing 25 and 30-yard wagons or buggies. This is booklet 845. Ask for it by that number from Cleveland Tractor Co., Cleveland, O.

Airport Construction:

Constructing and maintaining airports treated pictorially in this booklet, including levelling runways, removing snow, handling planes and generating electricity for field lighting and radio. Caterpillar Tractor Co., Peoria, Ill.

Tractors:

Allis-Chalmers LO oil tractors are well described and illustrated in a new catalog that should be of interest and value to contractors and city, county and state engineers who are charged with road and other public works construction and maintenance. Allis-Chalmers Mfg. Co., Milwaukee, Wisc.